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Bell Telephone MAGAZINE

THE IMPACT OF WAR ON LONG DISTANCE SERVICE

TELEPHONE SERVICE FOR WAR INDUSTRIES

AMERICAN SCIENCE MOBILIZES FOR VICTORY

OPERATING ARMY SWITCHBOARDS

THE TELEPHONE PIONEERS OF AMERICA

American Telephone & Telegraph Company

Bell Telephone Magazine

June 1943

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"The ideal and aim of the American Telephone and Telegraph Company and its Associated Companies is a telephone service for the nation, free, so far as humanly possible, from imperfections, errors, or delays, and enabling anyone anywhere to pick up a telephone and talk to anyone else anywhere else, clearly, quickly and at a reasonable cost."

A Medium of Suggestion & a Record of Progress

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Who's Who & What's What

in This Issue

THAT LONG DISTANCE LINES are crowded with the calls of the military services and war industries is not news to telephone people. Few realize, however, how heavy has been the actual increase in traffic since Pearl Harbor and what problems it has imposed on the Bell System. Both illuminating and authoritative is MARK R. SULLIVAN'S discussion of these problems and of how they are being met; for not only is he head of the Department of Operation and Engineering but he was for 29 years engaged in traffic and administrative duties with the Pacific Telephone and Telegraph Company before he was elected a Vice President of the A. T. & T. Company in 1941. His Bell System career was more fully described in this MAGAZINE for February, 1943, to which he contributed "The Bell System's Post-war Construction Program."

RAMIFICATIONS OF THE Bell System's contribution to the war effort are nearly as wide as the war itself, and many of them little known. The scope and importance of one of them is described by S. WILLIAM LIDMAN, whose familiarity with his topic comes from visits to many war plants and discussions with plant executives and Associated Company servicing groups. His interest in these matters was evidenced when, upon graduation from Harvard in 1920, he did graduate work in industrial management at the University of Pennsylvania. After six years with the Bell Telephone Company of Pennsylvania, he was transferred in 1927 to the O. & E. Department of the A. T. & T. Company, where he has since been engaged in various phases of sales and servicing work.

THIS HAS BEEN CALLED—among other things—a scientists' war, and it

Mark R. Sullivan

S. William Lidman

Robert W. King

Glen L. Whiteman

Samuel T. Cushing

is encouraging indeed to read in ROBERT W. KING's paper how coördination is being achieved among the many branches of science to direct all their resources of research against the enemy. After receiving his B.A. (1912) and Ph.D. (1915) degrees from Cornell, he taught there until 1917, when he joined the Western Electric Company as a physicist. He has since served in various scientific capacities with the A. T. & T. Company and the Bell Telephone Laboratories, and from 1929 to 1935 was assistant technical director in Europe for the former. He is one of the editors of the *Bell System Technical Journal*, and since 1940 has been Assistant Vice President of A. T. & T's Department of Development and Research.

ANOTHER LITTLE-KNOWN Bell System war activity, and one of importance out of all proportion to the number of System people directly concerned, is the operation of private branch switchboards for the Army, about which GLEN L. WHITEMAN writes. He has visited many of the switchboards—Navy as well as Army—to study the service problems which arise there. Starting with the Southwestern Bell Telephone Company in 1910, he held traffic assignments there, with the Long Lines Department, and with the New York Telephone Company before joining the traffic results section of the A. T. & T. Company's O. & E. Department in 1922. For the past 13 years he has had to do chiefly with activities which help PBX customers in the operation of their switchboards.

SECRETARY of the Telephone Pioneers of America since 1939, when he was appointed a staff assistant in the Personnel Relations Department of the A. T. & T. Co., SAMUEL T. CUSHING traces the development of the Association during a third of a century from small beginnings to its present position of importance. In plant work with the New England Telephone and Telegraph Company from 1906 to 1927, he was on the staff of the plant operation results engineer of the A. T. & T. Company for the next dozen years until his present appointment.

IN THIS SHIPYARD, portable telephones which can be clamped to a ship's rail, and which connect by means of marine jacks installed on outfitting docks, expedite the work after a vessel has been launched by bringing needed tools, parts, and men to the spot much more quickly than the messenger service formerly used. Said one yard official, "Your installation of telephones on board ships . . . has speeded up the outfitting activity . . ." While this picture relates particularly to "Telephone Service for War Industries," beginning on page 91, it is also illustrative of war-time use of the telephone which is the topic of other articles in this issue

With Additions to Plant Severely Curtailed, Increasing Numbers of Calls Make It Progressively More Difficult to Maintain Service Performance at Its Usual Level

The Impact of War on Long Distance Service

Mark R. Sullivan

The following article gives in narrative form the substance of much of Vice President Sullivan's testimony concerning toll board service before the Federal Communications Commission on December 16, 1942. Statistics for 1942, available at the time of the hearing only for the first ten months, have in most cases been revised to include the full year. THE EDITORS.

WITH THE FIRST RUMBLINGS of war, the nation reached for the telephone to get things done. Time: that became the scarcest and most desperately needed of war necessities. Greater and greater reliance was placed upon the telephone, because it makes time by saving time. It gets things done—fast.

All forms of communication service were called upon, and particularly the long distance message toll service. From early in 1939 to the end of 1942, the Long Lines toll volume increased 150 percent. In the short period of the last two years, the traffic has nearly doubled. The increase for this period alone is almost equivalent to the total level of business reached after steady and almost uninterrupted growth over a period of some 65 years.

Double the amount of business would seem to call simply for double the amount of plant and of operating force. Under the most favorable conditions, it would be far from a simple matter to double the far-flung and extensive Long Lines plant; under the circumstances which actually prevailed, it was an impracticable task. For the very materials —copper, aluminum, steel, lead, rubber, and many others—which are re-

quired for telephone construction were among the first to go to war on a large scale. And, quite properly, the amount of these materials available for telephone construction was sharply curtailed.

Copper, for example, had been used in building telephone plant at the annual rate of more than 90,000 tons; now only about 8,000 tons are used. Nor is it quite accurate to say "used," because today, for every ton placed in plant, more than a ton is salvaged and returned to the national copper pool. Thus, there is no drain on the country's copper resources because of telephone construction.

Despite the cross fire of rapidly increasing long distance traffic and rapidly diminishing materials for new construction, the service continues to be rendered efficiently. Over all, the results still average well—as is shown by the following comparison of results two years ago and now:

Then, 1.4 percent of the calls were delayed because of "no circuit" conditions; now 5.6 percent.

Then, the average speed of service on toll calls was 1.4 minutes; now it is 2.7 minutes.

Then, speed of service on 99.4 percent of the calls was within 10 minutes; now, on 96.4 percent.

Then, 93 percent of the calls were handled while the calling party remained at the telephone; now, 86 percent.

Most of the calls go through all right, as these figures indicate. That is an important fact, for telephone service is vital to every phase of the war effort. Just as it requires 75 trains to move an Army division and its equipment, it takes also thousands of telephone calls to get those trains loaded and to send the men and the supplies on their way. Thousands of calls are involved in building a ship, a bomber, or the yard or plant in which it is produced. So it is with every other important war activity. The telephone speeds the war activities—and the fact that most calls are completed promptly tells of an epic performance in which every telephone employee may rightfully take pride.

A system of priorities has been established to insure that vital long distance calls go through promptly. This does not deny to anyone the use of the service; but it does give priority calls precedence so that long distance calls essential to the national safety can be put through at once, even though the circuits may be overcrowded by such surges of traffic as inevitably occur during emergencies or catastrophes.

What the Averages Mean

WHILE THE average call speeds along normally to completion, not all calls fall on or near the average. Telephone lines are like highways: when too many people want to travel the same road at the same time, a traffic jam results. It is the same with telephone circuits: some voice highways, main lines and branch routes, which were engineered in size to carry a pre-war traffic, are now overburdened with war calls.

If the growth in calling were spread evenly over these voiceways, the effect of the increase would also average out evenly. But the increase in use of the service is anything but uniform: following generally the path of war activity, it varies tremendously in different localities.

Long Lines calls in Washington, D. C., for example, are 275 percent of the figure for January, 1941; in Dayton, 355 percent; in Norfolk, 493 percent; and in San Diego, 896 percent. These are a few scattered unusual and unpredictable occurrences. In Norfolk, for instance, on one recent day such an occurrence swept Long Lines traffic up to more than 600 percent over January, 1941.

The speed-of-service figures given

How MANY LONG DISTANCE CALLS go into the raising, training, and equipping of an army of 10,800,000 men? And how many calls pass between them and their relatives and friends at home? Answer those questions and you have in part the answer to why long distance telephone lines are carrying a greater load today than ever before

illustrations of the unprecedented bulge in toll calling in war-active cities.

Over and above these average increases, on individual days and in individual cities traffic is affected by surges which are brought about by

on page 82 are averages for many places—the good, the not so good, and those in between—all averaged out. But just as growth in calling has not been uniform throughout the System, so has circuit congestion been most pronounced in the cities most

affected by war activities. For example, while the Bell System figure for the percentage of customers released due to "no circuit" conditions was 5.6, the corresponding figure for Seattle—excluding calls to nearby points—was 23 percent; for Norfolk, Portland, and Atlanta, about 20 percent.

But the analysis must be carried still further, for even the city results are averages of the speed of service on all the circuit groups in the offices; and here too we have the good, the not so good, and the in between. This is amply demonstrated by the percentage of calls with speed of service over ten minutes on individual circuit groups between important cities. The System figure was 3.6 percent; but on the New York-Dallas circuit group, it averaged out to 44 percent in October, 1942, for example, and exceeded 25 percent on such groups as the Kansas City-New York, Cleveland-San Francisco, and San Antonio-Chicago.

The Complexities of War-time Traffic

FROM THE viewpoint of traffic volume alone, the problems of maintaining prompt toll service have been tremendous. But this increased volume has been accompanied by increased complexities in the handling of calls. It is impossible to evaluate precisely, or to set apart as wholly separate entities, the individual elements contributing to greater difficulties in handling these calls, since each bears upon the others in a marked degree. However, three fundamental factors are: more attempts required per call; a greater proportion of person-to-person calls; and greater length of haul requiring more switching.

The increase in these complexities can be measured by comparing the "units" per toll call. The term "units" is used in the sense of the relative work time required. In determining equipment and force requirements, calls are translated into units by the application of coefficients representing the different operating time requirements for each type of call. For instance, a person-to-person call which is put through on the first attempt is evaluated, at the originating office, at about double the requirements of a corresponding station-to-station call.

The net effect of the increase in these complexities in terms of work units is roughly the same as a corresponding increase in volume of traffic: almost exactly the same as to force and switchboard requirements and to a large degree as to circuit requirements. Since January, 1941, work units per toll call have increased more than 10 percent.

The average length of conversation is another factor which has increased facilities requirements. For Long Lines traffic, conversation time in the past year has increased 7.0 percent, and this longer conversation time is directly reflected in circuit requirements over and above the effect of the increased volume of calls and of the operating complexities already discussed. The combination of all these factors has a pyramiding effect on the requirements for operators, switchboards, and circuits.

Analyzing the Averages

THUS, GOING BEYOND the quarterly or monthly average and breaking it

down into results for individual days and for individual hours, it can be seen that an entirely different perspective of the service emerges.

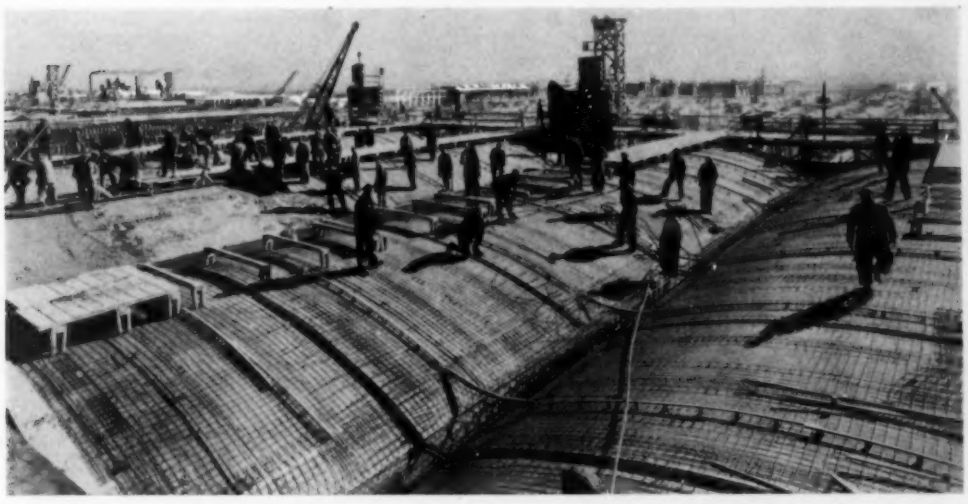
Even an average for an individual item for a specific period needs to be analyzed to determine how it is made up. An average comprised of individual calls ranging from a few points on the low to a few points on the high side of the mean reveals one kind of service. But an average made up of individual calls or intervals well below and others well above the average represents something entirely different. The customer whose individual call is delayed well beyond the average may appraise the service by that call, even though he may realize that the average speed of all calls is much faster.

Why Calls Must Move with Dispatch

TOLL TELEPHONE SERVICE must move with dispatch. Unlike other forms of communication, calls cannot be permitted to pile up for later disposition without adding complications. Delays are cumulative; and as calls are backed up, it takes more and more operator time, switchboard time, and circuit time per individual call. The result is that more plant and personnel are required to handle backed-up traffic than to handle traffic moving without delay.

This principle can be visualized by following through the train of events when a surge of recording signals occurs at a toll board.

Toll operators normally answer



BOTH ENDS A-BUILDING toward the middle: background as well as foreground in this picture show one factory. How many long distance calls does it take to construct a war plant of this size—and to tool up for and produce the airplane engines it will turn out? Long distance service is the right hand of the war industries

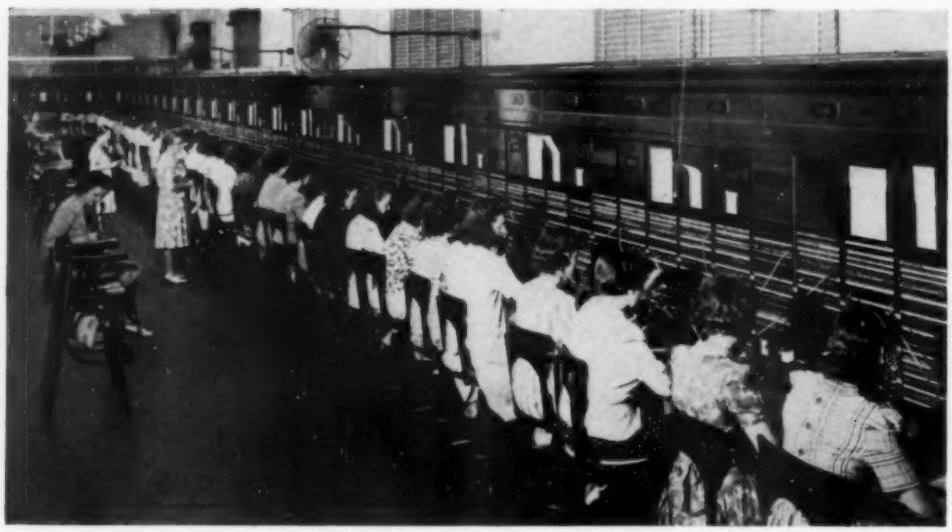
recording trunk signals within 10 seconds. Perhaps 5 to 6 percent of the answers may exceed this. If this percentage inches up to 8, 9, or even 10, some drag on the service occurs, but it is not serious. If it gets much above that, however, trouble starts to accumulate.

The signals become too numerous for operators to answer in order of their appearance on the switchboard, and thus some are answered very promptly while others may go unanswered for long intervals.

As this occurs, the calling parties have a tendency to hang up and call again—starting a new train of signals.

PBX operators are likely to call on two or more trunks simultaneously, causing more signals, further congestion, and unnecessary work by the long distance operators in answering more than once on the same call.

At about this point it becomes necessary for operators to stop completing calls in order to concentrate on recording the calls. This in turn necessitates releasing the calling party after he has given his call, even though a circuit may be available at the time. When this happens, some of the circuits are left idle, thus wasting circuit time.

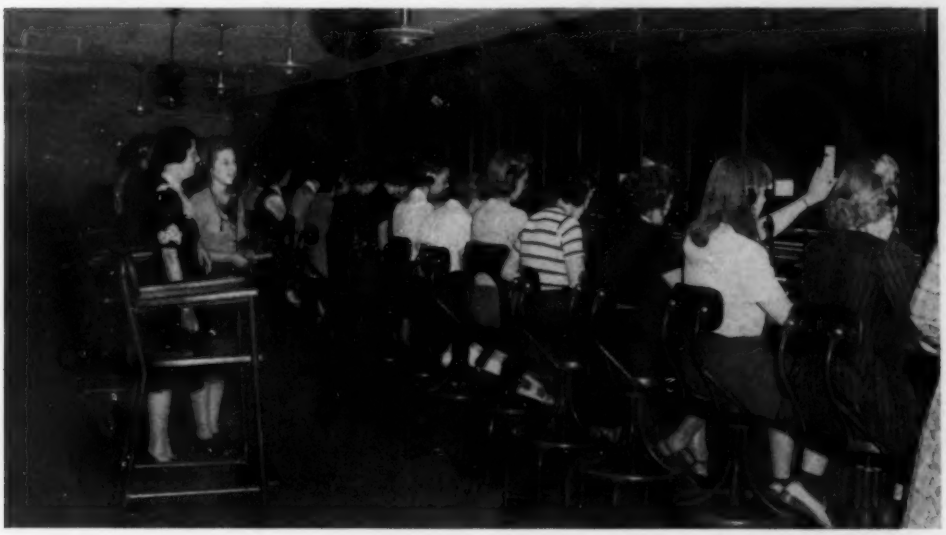


THIS IS BUT ONE—and by no means the largest—of the Bell System's long distance switchboards through which the nation's war calls are pulsing in ever increasing volume

When the recording signals are under control, the operators then undertake to complete the calls which have accumulated. First, the calling party's line is obtained over a switching trunk. The plant is designed for only a limited amount of calling back for the originating line, and thus switching trunks are not ordinarily adequate for a large accumulation of

backed up calls. The recording or recording-completing trunks on which the calls came in originally are not interchangeable with switching trunks and cannot be used for the call-back. Thus, with many operators becoming free at about the same time to complete the delayed calls, busy switching trunk conditions are encountered which cause delay and added work time.

In the meantime, as the delay increases, the calling party in many cases calls into the toll board to inquire about progress on his call. These inquiries are referred to in telephone parlance as "AG's," meaning "try again." This brings into play more recording signals, more operator time to record the "AG," to send the ticket to the delayed position, to match tickets, and to reach



TWO YEARS AGO this long distance switchboard, with its 20 operator positions, did not exist. It was placed in operation to handle the messages for an Army training area

Having finally obtained the switching trunk and the calling line, the operator then reaches the called station or party and rings the calling station. Some delay having ensued, the calling party in a certain number of cases may be temporarily unavailable and arrangements must be made to complete the call later. This means more attempts, more circuit time, more board and operator time. the calling party to report on the status of his call.

In addition to the "AG's," the calling party in some cases, being particularly anxious to get the call through, places a second call. In these cases the operating time and use of circuits and facilities is frequently duplicated.

This detailed illustration of what happens when traffic does not move

promptly illustrates clearly the cumulative difficulties that result from the backing up of calls. It is, of course, apparent that these difficulties are a matter of first importance to telephone traffic people because of their effect on force, switchboard, trunk, and circuit requirements.

When Calls Are Delayed

WHEN IT BECOMES APPARENT that, because of such a situation, long delays—of half an hour or longer—are in prospect over any route, the delay is "posted" so that operators may tell customers the approximate time their calls will be completed. Throughout 1941—until December 7—the posted delays on Long Lines circuit groups were few in number—two or three a day; occurred at widely scattered points; and in the main were caused largely by circuits put out of order by storms. Since Pearl Harbor, however, there has been a sharp upward trend in posted delays. Today, the number of calls affected by posted delays is running more than 150,000 a month.

As in the case of speed of service, the trend in percentage of toll board tickets representing calls not completed to conversation is upward. For the System as a whole the figure was 8.3 in the first quarter of 1941 and 13.7 in the fourth quarter of 1942. The full significance of a change in percentage cannot be grasped from the percentage figures themselves but must be viewed with relation to the base to which they apply. For instance, this difference of slightly over 5 percent means that on an annual basis, upwards of thirty million more calls are not being completed on the original ticket than would be the case with the completion rate previously prevailing. Many of the calls not completed on the original ticket are of course subsequently made, which adds to the volume of work and complexities.

The important conclusion to be drawn from our war experience to date—and it is borne out by our experience over the years—is that the greatest plant capacity can be obtained during the busy hours of the day only when the traffic is moving with reasonable dispatch. Overloads in the plant add to the complexities of operating and the net result is to reduce the business-day message-carrying capacity of circuits, switchboards, and operators.

In addition to the increased work resulting from higher volumes and changes in traffic characteristics, any special work the operator is called upon to do materially complicates the operating problem. This is particularly true in times like these when thousands of new operators are being added to the force. For example, it is possible to give emergency or war-urgent calls special handling; but should we undertake to give preferred handling to a large proportion of the calls, the complications might be such as to cripple the service generally.

DESPITE THE INCREASED TRAFFIC VOLUME and complexities and the shortage of facilities, there is a bright side to the picture none the less: some truly notable achievements in the face of those major difficulties.

Accuracy, and speed of answer to recording trunk signals, have suffered relatively little. Operators are courteous, as always, anxious to do everything they can to put the calls through.

By these yardsticks, the service holds up well.

Criticisms are fewer than ever before—a gratifying reflection of the public's sympathetic understanding that everything within the Bell System's power is being done to give the best possible service under today's conditions.

Long distance operators, and their sister operators at switchboards of all types, are imbued with a spirit which reflects a full realization of the important part they play in winning the war. "Voices of victory" are theirs as their working phrases go out over the wires to points nearby and to places across the country.

TRAFFIC CONTROL BUREAUS such as this insure the full and efficient use of long distance circuits. Pictured is one of several which have been installed since Pearl Harbor, supplementing those then operating

There have been large additions to the operating force: 150,000 in the past two years, to handle the increased traffic load and to replace losses. But the seasoned operators have stood by and coöperated with the newcomers, and together they have faced the challenge to the service—and have risen to it.

True to the finest traditions of the service, they are giving their best to a difficult job—and giving it willingly and cheerfully. "Soldiers of the switchboard" they have long been called. Never has that phrase had more nearly literal application than today.

This has been a discussion of traffic

problems. But the Bell System is a team—a team of more than 400,000 men and women. Whatever the positions they play in this grim game of winning the war, they play them together, and together they will contribute to the victory. Of incalculable importance to the country now is it that this nationwide telephone service shall be at all times dependable. These men and women are doing and will keep on doing their utmost to maintain it so, and thus to keep faith with their fellow workers —now nearly 50,000—in the armed forces.

IN NORMAL TIMES, with a substantial volume of material always in process of manufacture and installation, it is possible to obtain quickly from existing stocks most of the materials and equipment needed to restore telephone service, even when large amounts of plant are destroyed by disasters such as fires, floods and hurricanes. The situation in this respect has been greatly changed by the war. Not only have the chances of service interruption been increased by the possibility of sabotage and enemy action, but the quantity of finished products available which could be diverted to restore service has been greatly reduced by the sharp drop in telephone construction and manufacturing activity. It seemed prudent in the national interest to set aside a reasonable amount of the necessary materials and equipment for emergency restoration of service in the event of an emergency and to hold these materials and equipment at strategic locations where they would be readily available to any operating telephone company.

Approval of this plan was obtained from the War Production Board and the materials and equipment are now being acquired and warehoused at strategic locations. To as large an extent as possible, used materials and equipment already on hand are being employed, thus reducing to a minimum the requirements for new strategic materials and manufacturing effort. The investment in this war emergency stock, which may amount to four million dollars, will be carried by the Company.

From the A. T. & T. Annual Report for 1942.

Bell System Service Engineers Speed the War Effort by Adding to the Efficiency of Production Lines, Conserving Equipment, and Aiding in Plant Protection

Telephone Service for War Industries

S. William Lidman

THIS IS A STORY about the battle of production—about the industries which produce our bombers and tanks and ships and munitions. It tells of a three-fold contribution to winning that battle made by telephone people in the commercial department servicing groups.

There is, first, a contribution to the production efficiency of the war plants, and hence to the volume of war production, which comes from the more effective use of communication in manufacturing. There is, next, a contribution to the conservation of critical war materials. Finally, there is a contribution to the protection of the people and plants of the war industries in the event of enemy action, through improvement in the communications needed in their own air raid and sabotage protection plans.

To understand how these contributions come about, it is necessary to look into some of the war industries and see something of what has been involved in beating our plowshares into swords—in converting our industrial economy to war purposes.

The broad outlines are familiar. Automobile plants now make airplane parts; home appliance plants, machine guns; adding machine factories, bomb sights. Where was one day a corn field is, figuratively speaking, the next day a vast war plant turning out quantities of tanks or aircraft or artillery or shells. Overnight, it seems, a great machine tool plant doubles its output. Small manufacturers by the thousands—the subcontractors—furnish parts which the larger industries assemble into the engines and implements of war. The war demands mass production; mass production methods heed and feed its clamor.

What is required in the way of planning and engineering, when you start with a marsh and end up with a shipyard, or with a farm and end up with a powder plant, when you transform a furniture factory into one making gliders, taxes the imagination. Production objectives must be set, manufacturing processes envisioned, buildings designed. Machinery and other facilities for production and assembly must be engineered. Provision must be made for railroad tracks, loading platforms, cranes and conveyors. There must be facilities for power, steam, gas and telephone service—hundreds of telephones, perhaps, and the quantities of trunks and switching equipments needed to serve them.

A plant grows; the war effort cries for more and still more. New buildings are erected, thousands of people hired. Use of the trunks and instruments and switchboard grows likewise. Telephone service has to be engineered and re-engineered, addition after addition made in the capacity of the customer's telephone system, to keep up with the demand. Or a plant's production experts figure out a way to get greater output through some rearrangement of manufacturing facilities. Space must be re-engineered, cranes perhaps extended, changes made in lighting and power—and, nearly always, telephone service.

Servicing Work is Communications Engineering

THE WORK of assisting customers in the design of an establishment's telephone communications—increasing, decreasing, and changing them so that they will stay attuned to the organization's layout and production methods—is called servicing work, and in the Bell System is primarily the responsibility of a group of Associated Company commercial people usually called servicing representatives or service engineers. An outsider might call them communications efficiency experts. When a department is to be relocated or enlarged, or a new shop is to be erected, these are the men on whom customers depend for communications advice. Likewise, when a customer's switchboard appears overloaded, when trunk lines to the central office appear inadequate for the traffic handled over them, or when a hundred and one varieties of service problems arise, these are the men called on for assistance. In some firms, growth is so rapid or changes so frequent that servicing representatives have to be assigned to them on a full-time basis.

THIS IS NOT to say that customers get this type of assistance only when they ask for it. On the contrary, a large and equally important part of this work consists of making periodic reviews of customers' telephone communications on the telephone company's initiative. For the duration, these reviews are devoted mainly to those operations most directly concerned with war production, but within these broad limits they are thoroughgoing in scope. The representative deals not only with technical telephone matters, to eliminate traffic bottlenecks which might impede production, but also with the establishment's production processes, in order to coördinate telephone service

with them. He talks with executives, department heads, foremen, and sometimes with the workmen themselves—about their work, the part played by communication in it, and their communication problems.

The representative does not, however, do all of this work alone. In his study of production methods, he works jointly with the customer's own staff people. In many technical telephone matters he must, in turn, seek the collaboration of other parts of the telephone company organization. In matters pertaining to PBX operation, for example, he would seek the advice of traffic department operating people; in acoustical matters regarding signals and loudspeakers, the counsel of the engineers; in determining requirements for trunks and switching equipment, the assistance of the specialists on these subjects. Thus, the servicing representative coordinates for the benefit of the customer the service experience of the telephone company as a whole.

ON THIS PRODUCTION CONTROL BOARD, in a factory making parts for other war plants, is posted the status of each order in process. Telephone communication between foremen and the supervisor shown here, as suggested by a telephone company servicing representative, keeps the status report of each job up to the minute, enables the factory to notify customers of expected delivery dates, and supplants a lot of foot-work by factory expediters

The Need for Servicing Work

TO UNDERSTAND THE NEED for this work, it is necessary to put oneself for a moment in the customer's place. True, he subscribes for the trunks, telephones, and switching devices

which his people use or operate. But he has to decide how much service is needed, what it is to be used for, and how it is to be used so that it may contribute fully to the establishment's work. Users have to be trained, equipment properly engineered to the traffic, the system administered economically.

Obviously, many of these matters are technical and their handling requires training and experience which customers themselves rarely possess. They need the advice of telephone specialists which, generally speaking, only the telephone company is equipped to give. The company has therefore long assumed the function, through its servicing forces, of furnishing this advice as a regular part of its service to business customers.

GREAT AS WAS the value of this work for other businesses in other times, the need for it now by the war industries is many times greater. So many of them, and so much pertaining to them, are new.

Industry itself is, in general, new to war production. Many production processes are new. Vast numbers of people in the war industries are so employed for the first time. Finally, certain functions in industry are new; and several of these, including air raid and sabotage protection, depend a great deal for their effectiveness on good communication.

These "newnesses" have had a dual effect on the need for telephone servicing work. For one thing, little has been known about the most effective uses of communication in connection with these new industries and industrial processes. For another, production executives have generally not had the time to devote to studying how telephone service can be most effectively used in the new operations of their plants. At the same time, the situation places a high premium on the nucleus of people equipped to train and direct the inexperienced, and their need for time-saving communication is therefore great. As a consequence, to a large extent the telephone service of the nation's war plants—the task of making it right and keeping it right—has devolved upon the telephone companies' servicing forces.

The Contribution to War Production

THIS BRINGS US directly to the first of the contributions being made by the servicing forces to the war effort: the contribution to the volume of war production. It is a particularly fascinating field in communication engineering. It deals not so much with technical telephone matters as with production processes and the application of telephone service to them—with telephone service as a production tool.

This phase of servicing work is based on a very simple principle: that telephone service, being practically instantaneous, is essentially a device for saving time. It is this time-saving, multiplied by all the opportunities for it in the customer's operations, which represents the efficiency gained and reflects itself in production volume. Take any plant, find some way of saving the time of its men and machines, and obviously you enable them to produce faster and, therefore, more.

There is some danger in making it look as simple as this because it

prompts the questions: Can't war production people see this for themselves? Is servicing assistance really necessary? The principle seems so self-evident.

The answer is that of course industrial people recognize that more effective communication in their operations will improve production efficiency. Some of them, in fact, have an extraordinary understanding of this, as witness the use of our services in former days for coördinating assembly in automobile plants, whereby more than a thousand possible variations in the completed car—body style, wheels, color, upholstery, accessories—were accurately handled on the same high-volume assembly line. But the engineering of a procedure such as this takes study (and consequently time) which production people are now in no position to undertake. Nor are they, by and large, sufficiently experienced in telephony to conduct such study without technical assistance. Could even the technically trained production man be expected to know, for instance, that badly needed telephone service in the

HERE is one of several centralized files in an airplane plant, made feasible by telephone communication, which facilitate access to manufacturing records while also permitting a more efficient use of telephone lines. The arrangement resulted from a study by servicing representatives and the plant's production staff

explosive atmosphere of a paint-spraying room can be provided by means of an instrument designed for just such locations?

So it is not surprising that when a servicing representative approaches the management of a war industry and offers to make a review of its telephone communications, he is welcomed with open arms. Before going any further into the theory and technique of this work, let us illustrate some of it.

Some Examples of Improved Production Efficiency

THERE WAS THE CASE, for example, of the maintenance superintendent of a large machine tool plant. Now maintenance—the repair service—in a factory is a tremendously important function, for the break-down of a machine not only stops production on that piece of apparatus but may also disrupt other work which depends upon that production.

In this plant, when a break-down occurred, the procedure was to call this superintendent by telephone. However, since he was practically always busy supervising some repair job and might be any place within the vast area of the plant, he had to be located by means of the code signaling system. It made no difference whether the matter was imperative, such as the repair of a production machine, or relatively inconsequential; regardless of what he was already doing and where he was, he had to interrupt his work to answer his code.

To improve this situation, the servicing representative worked out a simple scheme with the customer. A central point was specified at which all maintenance calls would be taken, and at frequent intervals the superintendent called this point to get the messages left for him. Thereafter, interruptions to his work occurred only in emergencies. Not only were many minutes of his own time saved daily; the production of the entire plant benefited from his more efficient handling of the maintenance function.

OR TAKE THE MATTER of conferences. In war plants, because of their newness and the inexperience of so many of their supervisory people, the need for conferences is particularly great. True, many of them require that the conferees be present in person. Others, however, could just as well be conducted by telephone, and there is equipment available—frequently it is already installed in the customer's PBX—for this purpose. Many a supervisory man-hour formerly wasted in walking to and from an executive's office has been saved by the suggestion of a servicing representative that telephone conferences be employed when they will suffice.

Not only do these time-savings apply to supervisory and management people; the rank and file of workmen can be benefited also. This may be illustrated by the case of the highly skilled machine operators who, when they received each new job, had to walk several hundred feet to a stairway and up to a mezzanine storeroom to obtain the cutting tools and fittings needed, and back to their machines before they could begin the new work. While on this journey they were unproductive and their machines stood idle. It was a servicing representative who suggested the

more efficient procedure—which was adopted—of requisitioning the needed apparatus by telephone and having it delivered by messenger.

Communication Is Vital in Mass Production

THE BASIC PRINCIPLE of mass production is, of course, that work is so subdivided that particular individuals and machines perform comparatively few operations and, as a result, are able to perform them well and at high speed. One example of this would be in the machining of a part. One man (or group) performs a cutting operation, another a drilling operation, still another a bending operation; or there might be many such operations, each handled by a different group on different machines, each machine being set to perform one or a very few operations. Another example would be in assembling the product. Certain groups of people put together a few parts into so-called sub-assemblies. These, in turn, are joined together by other groups to form still larger sub-assemblies or "sections," and there are often many such stages before the various sections reach the final assembly line.

Thus, the operations of such a plant are closely interdependent. Sub-assemblies cannot be put together unless all of the parts are available, sections cannot be constructed unless all of the sub-assemblies are available, final assembly cannot take place unless all of the sections are available. The supervision of this flow of items so that they will be on hand when and where and in the quantities needed requires a great deal of communication—in which the telephone plays a large part.

The people whose job it is to supervise this flow in a plant of this type are called expediters, and our next example of a servicing contribution deals with them. The case in point occurred in a tractor plant, where the long assembly line was "fed" by parts and sub-assemblies such as castings from the foundry, gears from the machine shop, controls from the electrical shop, and bolts, bearings, etc. (which were bought) from the receiving room.

There were twenty expediters. When shortages in the various parts bins appeared imminent, they would go in person to the location which made or stocked the item needed. Considerable distances were involved; the receiving room, for example, was a mile from the assembly line. At the distant point, their task was to talk with the foreman and investigate the delay, but it was the latter who arranged to have the necessary supplies trucked to the proper location.

There was no telephone service either on the assembly line or in several of the parts-making shops. The representative's suggestion that little-used telephones elsewhere be moved to these points, and that they be used whenever practical in this "stock-chasing" instead of the foot-work communication method, was acted upon. As a result, so much of the expediters' time was saved that their number was considerably reduced. The men thus eliminated were given more productive supervisory work.

But the receipt of materials *into* the plant is of even greater importance, if anything, than their flow within it. Without them—without the raw stock and operating supplies,

the parts and sub-assemblies made by subcontractors—production could not go on. "The lack of a ten-cent gadget . . . can hold up our whole production schedule" is the way the head of a great bomber plant dramatized it. In expediting this flow, communication is indispensable and, naturally, the functions of following up suppliers and transportation companies to expedite incoming shipments constitute an important part of the servicing review.

Servicing Aids Many Operations

MANY OPERATIONS or functions in the war industries are so important to production and involve communication to such an extent as to warrant servicing attention. To those already mentioned should be added the dispatching of internal transportation, such as the plant's own trucks, railroad, etc. (dispatching is communication); learning the status of orders (getting information involves communication); locating plant supervisory people (which may involve the plant's loudspeaker or code call system); the plant's personnel department (the hiring and placement of new people requires much communication); and, not least, the work of the plant's foremen.

The last deserves a word of explanation. Because of the "newnesses" outlined earlier, skilled supervisors and staff people—foremen in particular—are spoken of by production executives as "the plant's most precious commodity." It is therefore imperative, they say, that a maximum of the time of such people be devoted to the supervisory, training, or planning aspects of their work. They say, moreover, that anything, such as the telephone, which conserves their time will contribute to the smoother flow of materials through the plant, the elimination of bottlenecks and spoilage (important in conserving materials), and thus to the speed of production.

Intentional emphasis was given to the communications involved in certain factory operations because many of these communications are so commonplace that they are scarcely recognized as being communications at all —that, for instance, a foreman *communicates* when he reports the need for maintenance, a workman *communicates* when he requisitions a tool. However, much of the servicing contribution to production efficiency hinges on the representative's recognition of this fact. Its significance is that since communication of one type or another—personal visit, telephone, mail or messenger service, pneumatic tube, etc.—plays such an important part in these operations, the communication media used for them must likewise be important. The greatest efficiency naturally comes from using each medium for doing those things for which it is best fitted.

THE servicing representative's approach to an industry's operations must therefore be functional rather than technical. The questions before him, with respect to any operation, are: How is it carried on? What communication is needed in connection with it? What communication methods are used at the present time? Is the telephone carrying that part of the total, and only that part, for which it is better qualified than other methods? He rea-

sons, "This firm repairs ships; is the telephone contributing all that it should to this work? or, "This department machines the castings; how can better communication help with that operation?" Likewise, for an individual employee his starting-point is, "This production-control clerk records the status of the factory's job-orders; how can more effective telephone usage help his work?"

In other words, the representative has to view telephone service, not as a telephone man ordinarily views it, but as a production man does. These viewpoints are not necessarily the same. We in the telephone business usually think of good service in terms of speed, accuracy of switching and good "overtones," of adequate stations, signals and switchboards; furnishing good service in this sense is an end in itself.

The production man, however, regards telephone service from the same viewpoint that he appraises the value of a piece of machinery or a manufacturing method; namely, in terms of what it contributes to production output. To him, good service as we telephone people view it, while important, is only a means to an end, that end being the efficiency of his own operations. To him, telephone service is a production tool—and a vital one.

THE INTERVIEWERS' TELEPHONES in the employment office of this aircraft factory are invaluable in fitting applicants into the right jobs. Often several calls throughout the plant may be required to place a person with unusual qualifications

Conservation—It Pervades All Servicing Work

BY NO MEANS SECONDARY in importance among the servicing contributions is the conservation of materials. It is, in fact, the most universal of them, pervading everything that the representative does.

To place this contribution in its proper perspective, it should be pointed out that there are really two sides to this conservation matter: what might be called a "supply" side and a "demand" side. When, by means of many ingenious devices—substitution of the less critical materials for the more critical, re-use, postponement of equipment replacements, and others—the Bell System's engineers find ways of getting along with a small fraction of the rubber, aluminum, and other materials formerly required, these would exemplify contributions to the "supply" side. When, on the other hand, a customer asks for an additional switchboard position because he believes his traffic requires it, and he is shown how, through a more efficient use of his existing service, his business can be as well served without it, this would be a contribution to the "demand" side.

This latter is the type of conservation contribution which the telephone servicing forces are making in many thousands of contacts yearly with military, government, industrial and other establishments. The field for it runs practically the entire gamut of the services—exchange, message toll, and intercity private line service.

So far as customers' use of exchange facilities is concerned, it is almost a truism with the servicing forces that service problems often result from conditions which either do not involve telephone equipment or that, when they do, the situation can be cared for by some minor addition or rearrangement. A customer's request for an additional switchboard position has been mentioned. What, to continue with this illustration, are some of the circumstances which might make this extra position unnecessary?

One of them, it is being found, is the extraneous or unnecessary work being done by some PBX attendants. A common example is the attendant who not only operates the switchboard but also acts as receptionist or file clerk or stenographer or perhaps all combined. When her work becomes too burdensome, her management is as likely as not, experience shows, to interpret it as a requirement for another switchboard position. But actually, the overload is on the attendant rather than the switchboard. The servicing remedy, obviously, is to relieve her of these extra duties and have her devote herself to switchboard operation.

FREQUENTLY, IT IS the PBX station users—even the rank and file of the firm's employees—who create unnecessary work at the switchboard. Consider, for example, the way so many of them place calls with the PBX attendant—saying some such thing as "Get me so-and-so" and then hanging up. Instead, therefore, of the simple operation of plugging into a trunk so that the caller himself can make the call, the attendant may have to look up the number, dial or pass the call to the central office, wait until

the called party is reached, and then ring back the caller. It is easy to visualize how much more operating time this requires. Multiply it by dozens and perhaps hundreds of calls a day, and you begin to get some idea of how easily a customer can believe that he needs more switchboard when in reality he does not.

of the day when there are relatively few incoming calls. This is far from a universal solution, however; the servicing representative would obviously not advise this when the postponement of making calls would in any way interfere with the organization's efficiency and thereby impede the war effort.

To THIS CONTROL CENTER of a war plant's air raid protection set-up, wardens and fire watchers would telephone reports of damage, and from it rescue and repair activities would be administered—also largely by telephone. A telephone company servicing representative assisted in planning the communication arrangements

While on the subject of switchboards, it seems desirable to add another illustration: that of the board which is really overloaded but during relatively short so-called peak periods. Here the remedy is sometimes simply to get the organization to spread the calling load, such as by making outgoing calls during times

Conservation Principles Applied to Trunks

CONSIDERABLE SPACE has been devoted to private branch switchboards because, after all, a position of switchboard is a relatively large piece of telephone apparatus and may require the use of some hundreds of pounds

of critical materials. But the same principles apply to trunks and instruments and signaling and other equipments. Let us take just one of these —trunks—as an additional illustration of servicing advice.

Now what are some of the things which create an artificial requirement for trunks? One of them is delays during the conversations caused, say, by having to consult records or files located at a distance; and the servicing recommendation here might be the Mohammed-and-the-mountain device of moving the files to the employees or vice versa. Still another is slow answers. Among other things this is often the result of inadequate telephone signals such as in noisy locations where the telephone bell cannot be heard. Here the solution is to improve the signal rather than provide more trunks. Delays in answering because the people called are away from their desks are also fairly frequent, and here again the correct solution does not lie with the trunks but rather in facilitating the pick-up of calls for the absentees; the servicing man's remedy might be supervision and educational work.

In all these conservation cases, the representative's technique is simply this: In connection with each service problem encountered, whether it comes to notice from a customer's equipment request or he uncovers it himself during his review, he explores the underlying cause and recommends the solution indicated by that cause. He is never satisfied with surface indications.

Toll Conservation Efforts

OPPORTUNITIES TO CONSERVE message toll facilities, jointly in many places with PBX traffic forces, are many.

A striking conservation achievement has been the substantial reduction in the number of customers' requests for what is called "time and charges." This term refers to the practice of asking the telephone company operator to inform the caller of the length of the conversation and cost at the end of each call made. It developed during this work that while some firms apparently needed this information to enable them to allocate telephone expense among different departments or different government contracts, other methods of furnishing it would suffice.

Also, much effort has been devoted to reducing the amount of so-called "directory work" in the toll offices—that is, looking up numbers in distant cities—by encouraging people to place intercity calls by number rather than by name and address. For example, PBX attendants have been assisted in maintaining lists of the telephone numbers frequently called in distant cities, and individual toll users have also been encouraged to keep such lists for their own use.

Effort has likewise been directed toward another toll conservation measure: converting calls unnecessarily placed on a person-to-person basis to station-to-station. This is not an easy matter—it is really a long-term educational process—primarily because there is no general rule for determining the choice between these classes of calls. The decision must be made by the caller. The issue is, simply, that if the particular individual wanted is likely to be on hand anyhow, or if someone else can handle the matter, the extra cost of a per-

son-to-person call, and the extra operating and circuit time which these calls require, have both been unnecessary.*

Conserving Private Line Facilities

MANY FIRMS subscribe for private lines to their branches or to other firms with which they do business in other cities. One of their advantages is that they enable the subscriber to communicate with the distant establishment without going through the usual message channels.

However, increasing loads on the regular intercity message toll lines make it highly desirable to conserve these private lines. The point is that securing the release of an existing private line for use in a message circuit group, or withholding one from a customer who asks for it, may in some cases provide greater call-carrying capacity than when set aside exclusively for the use of an individual customer.

The servicing forces are finding that while the war has increased the private line requirements of some establishments, notably military and government, it has diminished or changed them in others. The servicing task is, of course, to recommend the type of service best suited to current requirements and conditions.

Protecting Life and Property

THE CONTRIBUTION to the protection of life and property arises, as was indicated at the outset, from the servicing of customers' own air raid and sabotage protection plans. To the extent that the representative's effort implements these plans, and helps to defend a plant's precious human skill and machinery from injury, he at the same time makes a potential contribution to war production.

Many war industries—and other establishments as well—are making special provisions for handling such emergencies, paralleling those made by the municipalities for public protection. As in the case of the municipalities, the firms' regular protective forces, such as their own police, fire, and medical departments, have been augmented by employee volunteer groups, including warden organizations and rescue, first aid, fire fighting and repair crews. Control Centers or Report Centers have been provided for administering their protective and rescue measures. Furthermore, telephone communication plays much the same role in the protective arrangements of a business establishment as it does in the civilian defense arrangements of a community.*

THE PUBLIC air raid warning itself is generally an adequate communication. However, many manufacturing plants are so noisy that they cannot rely exclusively on it for "alerting" all of their employees. Some special arrangements must often be made for this purpose, using either a special alarm system or preferably, when available, the firm's existing signaling system for summoning people to the telephone. In addition, some firms which require extra time

* See "The Impact of War on Long Distance Service," p. 81.

* See "The Rôle of the Telephone in the Civilian Defense Organization," MAGAZINE, June, 1942.

for their precautionary measures receive preliminary and confidential warnings by telephone. Checking the adequacy of the plant's warning arrangements is one of the representative's more important functions during the review of this subject.

Some establishments, so as not to interrupt production until the raid is actually imminent, muster wardens and other key employees in the protective organization by telephone in advance of the general alarm for the entire employee body. The facilities and arrangements whereby this is done are likewise reviewed by the servicing representative.

Handling "Incidents"

ASSUMING THAT there has been a raid and that fires, casualties, and other "incidents" have occurred, two things are necessary. First, as in the case of the municipalities, these incidents must be telephoned to the Control Center by the wardens or by fire watchers stationed on the roofs of the plant's buildings. While it is sometimes necessary to provide telephones for reporting purposes, this is avoided wherever possible for conservation reasons. The representative suggests that existing telephone locations be selected for wardens' posts, and in some plants, roof watchers work in pairs—one going to the nearest telephone to report the incident, the other remaining behind to handle it. Second, the Control Center must dispatch the rescue forces to the points where they are needed, and this is also generally done by telephone. Here again the use of existing service wherever possible is urged.

Many of the arrangements made for handling reports of damage from air raids are also applicable in the event of damage from sabotage. Sabotage protection, however, sometimes requires special arrangements. Among these may be provisions for fast and uninterrupted communication with the plant's police force, and physical measures to protect the PBX against saboteurs as well as against bombing. While, for obvious reasons, it is not for the telephone company representative to recommend the precise physical measures which a customer should employ—reinforcing walls and roof, for example—he nevertheless discusses the general desirability of such measures.

IT IS OBVIOUS that a war industry's central office service may be of prime importance in an emergency. As is generally known to telephone people, the telephone companies have taken many steps to assure the ability of certain establishments and people in the community to make and receive central office calls under such conditions. Among them are procedures for dealing with traffic congestion which might delay or block incoming and outgoing calls, and for emergency restorations in case of service interruption. It is beyond the scope of this article to detail these measures. It may be said, however, that servicing work is required in some instances to make them effective, and that the servicing forces, because of their familiarity with customers' operations, are in an exceptional position to advise telephone company management as to the action along these lines which might be desirable for certain establishments.

Finally—One of the representative's more important services to the

customer consists of urging him to test his protection plan and its communications by means of fairly frequent rehearsals, as a device for detecting and remedying flaws.

THIS BUSINESS of servicing the telephone communications of business customers is not a new activity. It is, indeed, an old one—but now with a new and greater importance. What *could,* in our times, be more vital than helping shipyards produce more warships and cargo vessels, aircraft factories more fighters and bombers, tank plants more tanks? More essential than conserving scarce materials by making certain that their use for telephone service is made to the best advantage? More necessary than helping to protect the nation's production lines against enemy action?

The full scope of servicing work is not widely known, it is true. But its accomplishments are already such as to rank it among the more important of the System's many and constant contributions to the winning of the war.

CONTRASTS IN HORSEPOWER of half a century. New York's Broadway "street railroad" was changed from horse cars to cable cars 50 years ago this spring. The cable was pulled into the slotted tube in the street by the "thirty-six splendid horses" pictured at the left, according to the *Scientific American* of April 22, 1893. Contrasting with this scene is one of the cable-laying trains, with a combined 400 horsepower, which plowed the transcontinental telephone cable into the ground.

Industrial and College Research Organizations Contribute to Winning the War in an Unprecedented Coördination of the Nation's Scientific Resources

American Science Mobilizes for Victory

Robert W. King

Foreword

THERE ARE no accomplishments of the Bell System in which its men and women take greater pride than those marking the continuous activities of the Bell Telephone Laboratories in developing and applying the art of communication.

These accomplishments, reflected for decades in improved instrumentalities and systems for the transmission of electrical signals and speech, have been possible because vast resources of scientific knowledge have been devoted, as part of the System's general responsibility to the public, to a broad and fundamental program of exploration, experiment, and design.

To-day the more than 6,000 members of these laboratories, working long hours, are engaged on hundreds of development projects, requiring research, invention, and design, for the Army, the Navy, and the National Defense Research Committee.

That this should be both logical and inevitable will not surprise anyone who considers the vital part played by communications in modern warfare. Rapid movement of troops and supplies over far flung lines of action on land and sea and in the air are possible only when directed through effective communication systems. More and more the electrical transmission of intelligence is becoming the unifying influence pervading all branches of war organizations. It coördinates the movement of naval and aerial fleets; it enables infantry, tank columns and formations of aircraft to operate as a single unit. It shrinks a thousand-mile battle line to the compass of a single sector.

Because communication research is a fundamental interest to all engaged in rendering telephone service, we reprint below a description of the

nation-wide mobilization of science, including this research, that distinguishes and stimulates the war effort of America.

This description consists of excerpts from an address on February 1, 1943, before the New York Electrical Society, by Dr. Robert W. King, Assistant Vice President of the American Telephone and Telegraph Company. Dr. King's references to the National Academy of Sciences and the National Defense Research Committee will be of especial significance to readers of this MAGAZINE who remember that Dr. Frank B. Jewett, Chairman of the Bell Telephone Laboratories, is both President of the Academy and a member of the Committee since its establishment. THE EDITORS

IN THE UNITED STATES there are two main channels by which important military problems can be carried to civilian science.

On the one hand, Army and Navy agencies have properly gone directly to research and development groups and have chartered their services. The major portion of the war work which is in progress at many of the large industrial laboratories has come by way of this direct route.

On the other hand, to relieve the Services of part of the load of directing war research, to instil a fresh and untrammeled point of view, and also to assist in the distribution of projects to groups most competent to handle them, there now exist two principal civilian agencies to cope with the special problems which arise at a time like the present.

Of these authorities constituted to give scientific aid to government in the United States, the earliest to appear upon the scene was the National Academy of Sciences. Incorporated in 1863 by an Act of Congress, it was designated in the wording of the Act that the Academy shall, whenever called upon by any department of the government, investigate, examine, experiment and report upon any subject of science or art.

A continuing partnership was thus set up to be called upon alike in times of war and of peace. The responsibility of initiating intercourse lies, however, with the federal government; it was not contemplated that the Academy would offer unsolicited advice. Hence, it is an arrangement which, from time to time, must present significant limitations, more particularly as the body of scientific knowledge becomes larger and more involved, and the sensing of possible important applications, military or otherwise, not alone the making of these applications, becomes a matter for the expert in science.

Over twenty-five years ago, at the advent of the first World War, the National Research Council was created by President Wilson as a subsidiary organization to the Academy and, by virtue of its divisional organization and its more informal mode of procedure, possesses a flexibility and adaptability which could not readily be imparted to the latter.

An Early Origin

IN PASSING, it is perhaps of interest to note that the relationship between the federal government and the National Academy appears to have been patterned after that which, since the 1600s, has existed between the

British Government and the Royal Society of Great Britain.

In this connection, it may not take us too far afield to recall a famous, though long since past, instance of the tendency of political groups to regard the laws of nature as of no greater authority than those which they, themselves, write. I quote this instance from a brief history of the Royal Society by Professor L. J. Henderson, published in *Science* for January 10, 1941:

"One early question gave rise to a famous controversy concerning lightning rods, and in the year 1777 the affair degenerated into a political quarrel. Pointed lightning rods were the invention of Franklin, who had become a rebel. Benjamin Wilson, an Englishman, advocated blunted conductors, and the partisans of pointed conductors were regarded as friends and supporters of the Americans. The affair seems to have resulted finally in the resignation of the President of the Royal Society, Sir John Pringle, who had said to the King in supporting pointed rods: 'I cannot reverse the laws and operations of nature.' There is a story, not well founded, but widely believed, that the King replied: 'Then, Sir John, perhaps you had better resign.' At all events, Pringle did resign."

THIS BIT of history serves to remind us, not only that there was a time when the so-called "exact" sciences were sufficiently untried in their application to everyday life to make it politically expedient to ignore their conclusions, but, what is even more important in our present discussion, that there is such a thing as intrenched opinion which either willfully ignores new facts or, because of excessive familiarity with old facts, has become blind to the implications of the new. Moreover, we all recognize that one of the frailties of human beings is their tendency to guard a position once they have taken it.

Particularly can this be true in such a field as that of military tactics, where of necessity the more important ideas, plans, and developments must be held in close secrecy, so that effective criticism, both friendly and hostile, is largely ruled out. In such a situation only a group of superbeings established in the seats of the Chiefs of Staff could either be sure in their own minds, or could hope to preserve the confidence of the public, in respect to the freshness of their approach to the solution of matters of such huge national moment as those which a major war places upon the shoulders of a nation's military leaders.

Science and Engineering Are This Country's Best Protection

IN REGARD to the present war, the public recognizes that, above all its predecessors, it is a scientific contest. They know that science and engineering in the hands of the enemy constitute the greatest weapon being used against us. In this sense, it is not a secret weapon which Hitler hopes to wield. The public also knows that science and engineering in our own hands, and rightly and fully used, constitute the best protection to our democratic way of life. Nothing short, therefore, of such organizational machinery as will result in commingling the best of American science and engineering with the best American military brains and skill can be

expected to have any chance of holding the confidence of the public.

So far have we journeyed since the days of the lightning rod episode that now, once science has spoken unequivocally, the politician and the man in the street, equally with the scientist, are alert to the significance of its voice and anxious that it be interpreted for him by those who are most competent. And of the military expert it may be said that now, more than ever before, is he eager to catch every word. He, too, is anxious that at a critical time like the present the best of civilian science be made readily available to him.

THIS BRINGS US to the second of the civilian agencies and to the special organizational creations of World War II. I have already pointed out the limitation under which the National Academy of Sciences and its subsidiary, the National Research Council, function: namely, that they can only undertake government (or public) work when asked to; they cannot initiate projects, nor have they available a reserve of public funds upon which to draw.

By the spring of 1940, and therefore preceding Pearl Harbor by nearly two years, the need of strengthening the national set-up in this respect emerged to view. By that time events had progressed far enough to show that the chances of the United States getting into the war were alarmingly large. The Army and Navy were beginning to call for aid from individual scientists and from certain scientific institutions. This resulted in a scientific tide toward Washington and certain other centers, which, had it not been checked, would have crowded countless thousands of scientists into strange environments and up-rooted them from their equipment and their colleagues, with the result that they would have become quite impotent to shoulder the load about to be placed upon them.

So it was that, by the early spring of 1940, a certain small group of well-known scientists determined to try to rectify this unplanned approach to the mobilization of science, threatening as it seemed such dire consequences to the country.* The solution seemed to be some new organization which could play an independent part in focusing the scientific personnel and resources of the nation upon its rapidly augmenting military problems.

The NACA Prototype

A PROTOTYPE for the new organization already existed, a prototype which had been created as far back as 1915 for the express purpose of establishing coöperative relations between military and civilian groups. This agency is the National Advisory Committee for Aeronautics, commonly known as the NACA. The law which created the Aeronautical Committee provides that it shall "supervise and direct scientific study of the problems of flight, with a view to their practical solution," and also "direct and conduct research and experi-

* Among the members of this group were Dr. F. B. Jewett, Chairman, Bell Telephone Laboratories, Inc., and President of the National Academy of Sciences; Dr. Vannevar Bush, now Director of the Office of Scientific Research and Development; President J. B. Conant of Harvard University, now Chairman of National Defense Research Committee; and President K. T. Compton of Massachusetts Institute of Technology, now one of the members of NDRC.

ment in aeronautics." It is regularly granted public funds by Congress to create and operate research facilities. The Committee is composed of fifteen members, including two representatives each of the War and Navy Departments. Throughout its more than twenty-five years of existence, the NACA has given ample testimony of how fruitful coöperation between civilian and military personnel can be as a means of meeting the requirements of the latter.

Birth of the NDRC

WHEN, some three years ago, the small initiating group of scientists to whom I have referred became convinced that broad participation by civilian science in the whole military program was likely to be essential, and they envisaged the NACA as typifying the sort of organization they thought ought to be created, a somewhat duplicative plan was submitted to President Roosevelt for such action as he saw fit to take. The proposal appealed to him and he decided to carry it into effect by executive order. This order conferred power upon the Committee to take the initiative in many scientific matters which it believes to have military significance. It directed the Committee to develop coördinated plans for the conduct of scientific research in the war program in collaboration with the War and Navy Departments. Moreover, and this is especially important, the order directed the committee to initiate and support scientific research on the mechanisms and devices of warfare with the object of improving present ones and creating new ones.

Thus, in June, 1940, the National Defense Research Committee, more familiarly known as the NDRC, was born. It was composed of eight members, two of these high-ranking men from the Army and the Navy, five civilians well known for their experience in organizing and directing both fundamental and applied scientific research, and an eighth member, the Commissioner of Patents.*

The executive order creating the NDRC omitted any reference to the biological sciences, and, in particular, to medical science. This omission later called for attention and committees representing these latter groups of sciences now report on equal footing with the NDRC (which deals with the physical sciences) to a supervisory body, the Office of Scientific Research and Development, commonly abbreviated OSRD.

FEW INDIVIDUALS indeed will question that the present organization marks a big advance over this country's previous attempts to focus science upon the problems of a military campaign. American science is now able to study the technique and problems of offense and defense at first hand, being no longer constrained to a largely advisory status. This, in itself, is beneficial since fresh eyes—and particularly the trained eyes of the scientist—frequently result in fresh diagnoses.

There is perhaps no briefer way of illustrating the expanding role of the OSRD as a mobilizing and imple-

* At present the representatives of the Services on the NDRC are Maj. Gen. C. C. Williams and Captain Lybrand P. Smith; the civilian members are J. B. Conant, Chairman; Roger Adams, K. T. Compton, F. B. Jewett and R. C. Tolman. Conway P. Coe is Commissioner of Patents.

menting organization than to state its successive budgets. During 1940–41, its first year of existence, the NDRC authorized research projects which totaled about $10,000,000. At the time, that seemed a large budget to all concerned. The OSRD, during its first year of existence (second year of NDRC) guided the expenditure of about $20,000,000 throughout the whole scientific field, biological as well as physical. But actual entry into the war brought a gigantic increment. The fiscal year 1942–43 (ending in June, 1943) will probably see the spending of about $100,000,000, while the budget for 1943–44, although still in an embryonic stage, promises to be even more impressive.

Modus Operandi

THE MANNER in which the expenditure of these funds is initiated and supervised can be sufficiently illustrated by reference to a single branch of the full organization, namely, the NDRC.

For supervisory purposes the scope of NDRC is divided into eighteen divisions, each under the direction of a "Chief." To expedite discussions, surveys, and the general handling of work, a further breakdown has been found desirable, the result being that each Division comprises a few so-called Sections. The work of a Section is entrusted to a Section Chief, who in turn calls to his aid certain individuals who become permanent members of his Sectional Committee and who are known technically as Members. Then there are others who may be asked to render advice and assistance from time to time and hence are called Consultants. Members and Consultants are officially appointed by the Director of the OSRD and are designated only after official clearance by the Federal Bureau of Investigation and the Army and Navy Intelligence Offices. Full consideration, therefore, is given to the basic requirements of the military services as regards the confidential handling of their problems.

None of the five civilian members of the NDRC is paid from public funds. A few of the Division Chiefs and Section Chiefs are; but none of the other Members nor the Consultants are. And, all in all, the fraction of the total budget which goes to salaries is less than three percent. The large remainder of personnel who are not paid are, without exception, loaned to the government by their employers. Frequently the loan is complete, the work being of such scope and urgency as to require a man's full time.

Thus, with about 1,000 of our leading scientists encompassed in the present NDRC organization and loaned to the country, it will be seen that the federal government—even the forgotten taxpayer—is receiving a donation from civilian agencies which it would be difficult to express adequately either in words or in figures behind a dollar sign.

AS JUST MENTIONED, only three percent or so of the budget represents payment to personnel. The large balance therefore goes to defray the cost of the scientific projects undertaken. For the most part Members and Consultants do not carry on the research and development projects which the NDRC decides to promote—their duties are advisory and administra-

tive. They formulate the problems which they believe it important to undertake, and then arrange with various scientific institutions to carry on the work.

The scheme naturally places the chief burden for performance of each contemplated task upon the contractor, and the success or failure of the OSRD plan as a whole will in large part depend upon the ability of its contractors to deliver. By serving in the rôle of such contractors, the well-organized and well-integrated laboratories of industrial science, and also of fundamental science, are rendering services to the nation which it would be impossible to assess merely in monetary terms.

For when an emergency impends, one cannot just bring physicists, chemists, mathematicians, and engineers, to say nothing of the other specialties, together within the compass of a single organization and expect them, at a word of command, to begin functioning as a sort of super-intellect. The full power of any such composite group can only be built up gradually through the accumulation of experience and with the knowledge, born of practice, as to how the units can best merge their individual efforts and the products of their individual brains. But, fortunately, so intimate are the relationships between the problems of peace-time science and those of war-time science that the knowledge, techniques, and skills of the former are almost immediately applicable to the latter. Hence, rather than create war-time agencies to handle war-time sciences, it is far more effective to carry the war problems to peace-time agencies.

In another respect also the availability of industrial laboratories as contractors to undertake military problems is proving to be a most valuable circumstance. This comes about as a natural result of the motive behind industrial research; these laboratories, and these alone of all the scientific institutions, have been schooled in certain methods which, in a crisis like the present, are invaluable. Their special skill may be described as the ability to find such expression for their scientific results that the ensuing problems of engineering development and design can be solved in a minimum of time. And like industrial research, the usual objective of inquiry in military research is some weapon or instrument or product which is wanted by the Services as soon as it can be proven workable or effective—and then is usually desired in large quantities.

From Laboratory to Production

THIS SUGGESTS that there is usually a considerable gap to be bridged between the completion of laboratory research and the initiation of factory production. In reality, the bridging of this gap, contrary to what is perhaps general supposition, proves to be a major undertaking in the launching of a new device or product into service.

It can be stated almost as a general rule that more time and effort have to be spent in preparing research laboratory models for production than are consumed in giving birth to these same models from the results of fundamental science. In fact, the latter interval is usually two to three times as long as the former, albeit every effort is made to mini-

mize it. Those who have had actual association with these problems of engineering design, in which the aim is to perfect an article capable of giving satisfactory performance in service, and yet being susceptible of rapid and large scale production, will need no reminder of what the availability of large industrial laboratories means at the present time to the nation's war program.

RETURNING AGAIN to the OSRD, the number of active projects which it has approved and contracted out to universities and industrial research laboratories now stands around 1,400, while the number of contracting institutions is over 400—about 100 colleges and 340 industrial establishments.* Another 600 contracts have already been completed. The contracts vary all the way from those involving a few thousand dollars to those calling for outlays of two or three hundred thousand dollars per month.

You will recall that only those military research projects which channel through the OSRD add up in this year's budget to about $100,000,000. As to the many other scientific projects being handled directly between the armed services and the research institutions of the country, it is impossible to estimate what they total. It seems a safe guess, however, that the war science budget of the nation is considerably larger than was any peace science budget. This conclusion is borne out by the quite general fact that among the large industrial laboratories, budgets are the biggest in history, and the major portion represents work which has been authorized through some war channel *other* than the OSRD. There can be no doubt, therefore, that American science is all-out to win the war.

*The Bell Telephone Laboratories exemplifies the industrial research organizations that were prepared, through size and experience, to accept large projects immediately. EDITORS.

The Country's Scientific Personnel

THE QUESTION is frequently asked as to how many research workers may still be considered as available for induction into the nation's war effort. According to a recent survey the answer is, *very few* indeed.

In round numbers, the scientific personnel of the country who are engaged in research amounts to about 100,000, perhaps one-quarter of whom are scattered among the universities and other institutions of advanced study, while three-quarters are to be found in the technical branches of modern industry. The survey reveals that of university research workers only some five percent are still available, which is the equivalent of about 700 full-time investigators. Among industrial laboratories in the fields of physics, chemistry, electrical and mechanical engineering, about seven percent of the personnel are still available. The survey also shows that 13 percent of the mathematicians and 17 percent of the biologists in the research field were at the date of the inquiry free for war assignments.

An earlier paragraph set forth the rôle of OSRD and its coöperating agencies as a sort of national insurance policy. Its fundamental obligation to the public and to the military services alike is to make certain, to the best of its ability, that in the field of science everything humanly possible is being done to expedite the na-

tion's war effort. In view of the responsibility which rests upon the shoulders of these agencies and the importance attaching to the work they are initiating and supervising, it is natural to raise the question as to how and where the various problems which comprise their program originate.

The record of some two years' operations shows that many are proposed directly by the fighting forces. Others come out of joint deliberations involving OSRD departments, and Army and Navy representatives. Still others are proposed by individuals, and some of these latter come by way of the Inventors' Council. A good many ideas have naturally bobbed up repeatedly, but in general it is not the most valuable suggestions which are oftenest proposed.

But there is always the question of priorities. In the nature of the case it is not possible to push all the many projects along with equal energy and speed. Some deserve the right of way over others. But in this regard the whole situation is fluid and not static. It may happen, for instance, that a project which initially carried an "A" priority drops to the "B" or "C" category, and is replaced by one from below. Such exchanges sometimes result from the shifting demands of the war but may equally well result from the manner in which certain projects, originally conceived of as unrelated, can reach a stage that promises particularly valuable results if they are brought together and coordinated.

ANOTHER QUESTION often asked concerns the steps by which the OSRD certifies a problem or project. What sort of gauntlet does it have to run before a decision is reached to spend public money on it? The answer is somewhat as follows.

Considering NDRC, just by way of illustration, the eight men who comprise it meet together at regular weekly intervals and have before them for review proposals which have come to the attention of the various Sectional Committees during the preceding week. At the Sectional Committee and Division discussions, representatives of the Army or Navy have a chance to consider each proposal and express their judgment as to its importance. It is a résumé of these preliminary surveys which reaches the weekly meetings of the NDRC, and here again, as you will recall, there are Army and Navy representatives.

Thus, the manner in which the proposed developments, in case they prove successful, will fit into and affect present routines of the fighting forces is given consideration. At the NDRC meetings there is also opportunity to weigh the relative advantages of various proposals in case they coincide as to objective or conflict in their demands upon personnel or laboratory facilities.

While the whole civilian group looks to the military personnel for expert counsel, it should be borne in mind that the latter has no veto power. If a civilian group becomes convinced of the merit of an idea and can carry its point with their nonprofessional colleagues of the top committee, it is possible to undertake almost as complete and thorough an investigation of the proposal as though there were military compliance. This means that the mecha-

nism now in operation has moved a long way beyond that which functioned in the last war! Then the civilian group, in effect, waited politely on the doorstep of the military to be asked to participate; now they are an autonomous body of experts possessing funds sufficient to test out their own ideas. Not only the presumption, but the evidence thus far available, speaks in favor of the latter arrangement.

It results in both the civilian and the military groups being put more on the alert. Not only has it resulted in the introduction of valuable military innovations, but it has also in certain instances resulted in the Services abandoning schemes which from the broader scientific view failed to stand analysis. It thus provides a degree of national protection and reassurance which probably could be obtained in no other way.

This is not said to imply that dissension has arisen between the two groups. So far as I know, no major instance has occurred in which any one of the civilian agencies has decided to take the bit in its teeth. But the full and true appraisal of ideas is one of the most difficult duties ever placed upon any organization, whether civilian or military, and it is well attested that the present interplay of discussion between the groups has been of inestimable benefit in clarifying the thinking of all. Coupled with this there is now incontrovertible evidence that scientists, both academic and industrial, on the one hand, and the professional military, on the other, working intensively together, have been spurred by competition, each gaining as the months have passed increased confidence in the value and essential soundness of the other's knowledge and judgment.

MORE THAN ninety per cent of American scientists are engaged in beating the Germans and Japanese.

More than ninety per cent of American scientific laboratory facilities are devoted to the same task.

American scientists are working at this job six or seven days a week, long hours, with few interruptions.

They are getting somewhere, too.

Every now and then the Germans and the Japanese have an unpleasant surprise.

They find that American science has caught up with them and passed them.

It is reassuring to us and discouraging to our enemies, for American scientific facilities are the greatest in the world. And they are functioning.

Little by little, some of the things that have been developed become public, but most of them you won't hear about until after the war.

But now, without the details, you can have faith that American research—industrial and academic combined—is rapidly giving our fighting forces an advantage.

Along with other American industry, the Bell Telephone System has its own Bell Laboratories—the largest in the world—working overtime for victory.

From an A. T. & T. advertisement entitled "Reason for Confidence."

More than 2,000 Bell System Women Are Handling Calls at Many of the Army's Private Branch Exchanges, Thereby Releasing Military Personnel for More Active Duty

Operating Army Switchboards

Glen L. Whiteman

NO ONE REALIZES BETTER than do telephone men and women the force of the impact on communication services of the Japanese attack on Pearl Harbor on December 7, 1941.

With the first flash of the news came a deluge of telephone calls at the nation's switchboards, particularly those of Army establishments everywhere in the United States. The need for trained and skillful operators at these establishments was so intensified that it was only a matter of hours before certain Bell System companies were requested to take over the operation of several private branch exchanges located at important military posts in this country.

A year and a half has now passed since that emergency was met by assigning to this new task trained Bell operators who took their positions at those switchboards—thereby releasing military personnel for duties elsewhere. It is interesting to summarize, in a backward look, the extent of this System contribution to the war effort, of which so little is known.

In the first year of war, the operation and supervision of approximately 200 Army private branch exchanges, with 600 positions and 2,000 operators and supervisory people, became the direct responsibility of Bell telephone companies. Many more have since been added as the Army continues to expand.

These private branch exchanges are located at air fields, arsenals, supply depots, army headquarters, hospitals, and at various forts and training camps. Some are in large cities, others in small communities or even in isolated places miles from the nearest town. One of the camps, where ski troops are trained, is situated over 10,000 feet up in the Rocky Mountains.

The switchboards are either manual or dial, and vary in size from

one-position installations requiring only a few operators to those requiring as many as 45 operators.

In normal times, these Army switchboards are manned by either Signal Corps men or by women civil service employees. As the threat of war grew, in 1941, practically all soldier operators were replaced by civil service women. Now it is Bell System operators who are handling the calls—although included among them are some of the women who, as civil service operators, had been working at the same switchboards when the telephone companies were called on to take over the operation, supervision, and maintenance of the private branch exchanges.

Army officers and men agree that the change from the broad-shouldered soldier operator to the slender girl is a welcome improvement. For his part, the soldier is well pleased to be transferred to other duties.

During World War I, at the request of the United States Army Signal Corps, the Bell System operated many private branch exchanges located in Army mobilization centers and cantonments—as they were known in those days. Some time before the start of World War II, the Signal Corps again made preliminary arrangements for this form of service in those military establishments where such operation might be desired if and when a major emergency should be declared. This gave the telephone companies opportunity to make general plans for the operation of such switchboards when the Signal Corps requested.

More detailed preparations were made early in 1941, when representatives of the telephone companies which had military establishments in their areas attended a traffic department meeting to discuss the providing and training of operators, their

THE COMMANDING OFFICER and the Camp Signal Officer inspect the post's switchboard as its operation is taken over by a Bell System force

housing and transportation, and other problems related to the operation of these switchboards.

Some time later, at the request of the Signal Corps, surveys were made at every army establishment then in existence, not only to determine the requirements for telephone company operation of the switchboards but also to view the adequacy of equipment and the need for expansion and changes in plant.

SOLDIERS such as these are released for more active duty when Bell System operators take over the handling of Army switchboards

Thus it came about that because of advance planning and coöperation with the Army, the telephone companies were ready and able, before the smoke had ceased above Pearl Harbor, to assume the responsibility for operating the switchboards at those places where they were asked to step in and take over.

That process is still going on—although as the Army continues to grow it is nowadays not so much a matter of "taking over" as it is of operating the switchboard from the day of its installation.

The Signal Corps works closely with the companies in planning tele-

GAS MASKS were proved by test to be no insuperable obstacle to the operation of this switchboard at an Army post

phone requirements for a fully garrisoned camp. When a new military location is planned, meetings are held in the Associated Company area in which the establishment will be lo-

cated, with staff officers and telephone company engineers participating. There all the many important factors for service are considered. The size and type of switchboard, outside plant arrangements, the housing of people, and the equipment required are decided. This includes rest-room facilities for operators, and dormitory arrangements if employees are to live at the camp.

A TYPICAL DORMITORY for Bell System operators on an Army post. On the steps are the chief operator, the housekeeper, and the hostess

The same sort of check-up takes place at an existing establishment when more facilities are needed or when arrangements are being made for the telephone company to take over the operation of the camp switchboard.

Actual operation of the Army's switchboards—in addition to the Bell System's many other war-time responsibilities—is a good deal of an undertaking. Fortunately, there exists in each of the Associated Companies an organization which has been of great value in meeting the telephone service needs of the rapidly expanding military forces.

FOR MANY YEARS the traffic departments of Bell System companies have made it a practice to give practical help to business customers in the operation of their private branch switchboards. More than 125,000 switchboard attendants (operators) are employed—not by the telephone companies but by the firms having the private branch exchanges on their premises—to operate these switchboards. To assist these business customers, the traffic departments main-

tain placement bureaus which will supply trained attendants on request. In large cities, they give training courses where women without experience may receive instruction in PBX operation and operators may take "refresher" courses. To help these attendants to give and their employers to receive satisfactory telephone service through their switchboards, telephone company instructors make periodic visits to these business customers and their operators.

A PLEASANT ATMOSPHERE and comfortable furnishings are features of the living rooms of Army dormitories for operators

Thus, while taking over and operating the Army switchboards has presented a good many problems to the telephone companies' traffic departments, neither experience nor technique has been among them. But providing enough operators, with the necessary special qualifications, assuredly has. Furnishing telephone service to large Army establishments has raised the problem of operating personnel since the first big camp was activated. Operating the Army's switchboards has simply—and greatly—intensified it.

OBVIOUSLY, a big new military establishment largely increases the traffic through the telephone company's central office which serves it. Often the nearest center of civilian population is a small town which cannot provide the additional operators needed to handle the greatly multiplied numbers of calls. Then it becomes necessary to transfer operators from other localities where the employment problem is not so acute. These operators, brought in some times from a considerable distance, must be housed—

in a community perhaps already overcrowded. In some places the telephone companies have rented or bought large houses and converted them into dormitories.

When the telephone company is requested to operate the same military establishment's own private branch exchange, which handles the Army's local and long distance calls through the central office and all the calls on the post as well, that just increases again the number of operators needed. If, as in the preceding paragraph, the near-by town cannot provide them, then they too must be brought in from some other place. If the camp is far from town, or transportation is too difficult, then a dormitory must be furnished for them on the camp grounds.

THE TELEPHONE COMPANIES provide dining service, in cheery dining rooms such as this, in a few of the operators' dormitories at camps where it would be difficult for them to obtain meals elsewhere

NOW TO GET BACK to some of the interesting points about actual telephone company operation of Army switchboards.

These switchboards, operating 24 hours a day, are the nerve centers of the Army. They handle a large volume of calls. By way of example, more than 50,000 local and 600 long distance calls *originate* daily at one large Army camp switchboard. Most of the calls are concerned with Army business, of course; but an occasional incoming personal call to a soldier from mother, dad, or the "best girl," which is handled through the private

branch exchange instead of a public telephone, is also important.

Another typical Army camp has more than 1700 buildings encompassed in a 6-square-mile area, which from the air looks like a good sized town. This camp is served by a 1000-line dial private branch exchange with four switchboard positions and a force of 20 operators.

The service given at these private branch exchanges compares favorably with that given in central offices. All operators are experienced—part of them, as already mentioned, being former civil service employees who had operated the same switchboards under Signal Corps supervision. The additional people are selected from near-by central offices whenever possible, and are given the necessary training in the operation of the private branch exchange.

Public transportation facilities are used by the operators so far as possible in getting to and from this work, but these are often inadequate, particularly in the early and late hours. In some cases, it has been necessary to fit the hours of work to meet bus or other transportation schedules. Taxicabs and telephone company cars are sometimes used when other means are nonexistent.

ONE MORNING in the spring of 1941 the private branch exchange located at Camp ———— was turned over to 20 Bell System operators, who replaced soldiers of the Signal Corps. This was the first Army switchboard to be taken over for telephone company operation. Since the camp is about 20 miles from the nearest town, the Army assigned a building near the Signal Corps office as a dormitory. The girls were welcomed by the General in charge of the camp, who gave a reception for them which was attended by a number of officers.

Since the spring of 1941, the Army has provided about 20 dormitories in camps located in isolated places beyond reasonable traveling time to the employees' homes. The Army consults with the telephone company regarding the design and size of each dormitory before starting construction, to make sure that it will house the telephone girls in comfort. Equipment and furnishings are, in general, similar to those provided for Army nurses. The bedrooms, designed to accommodate two girls to the room, and the recreation quarters are attractively furnished. Kitchenette facilities are provided for snack meals in the evenings and for preparing food for those who may be indisposed.

The girls generally obtain meals in a near-by officers' mess or club, at a table assigned for their use. If an officers' mess-hall is not within reasonable walking distance, the girls usually eat in a service club or post exchange restaurant. In a few cases the telephone companies provide restaurants for the operators.

The camp's commanding officer usually takes considerable interest in the operating force, and encourages their participation in the social activities at the camp. The Signal Officer in charge of the private branch exchange usually makes it a point to keep acquainted with the operators and to see that they meet other officers. The operators have access to many of the amusements that are available to the camp personnel, and they are encouraged to participate in

as much outdoor activity as seems desirable. Usually there are unrestricted areas for walking, and at one of the older forts riding horses are available for a small fee.

At a camp for training ski troops, the operators participate in many of the winter sports, such as skiing and bobsledding. To add to the spirit of Christmas at this camp, a tree-cutting jaunt was made to the near-by hills to bring back a Christmas tree. At another camp, located in the South, the operators have made an attractive flower garden around their quarters. This is the only garden within miles.

The operators also attend the movies and dances at the service clubs, and have occasional small parties in their quarters, where some of the soldiers may be invited to play cards, listen to the radio, and take part in such other entertainment as they would enjoy in their own homes.

Although the restrictions are few, the operators are required to be in at the same hours as the men, and must be escorted when going out in the evening. The telephone company hostess meets the girls' escorts, and since she is responsible for their general well-being, she is kept informed of their whereabouts when they are not in the office or dormitory.

SOCIAL EVENINGS in the dormitories' home-like living rooms, and participation in a camp's recreational activities, help the operators' off-duty hours to pass pleasantly

THE OPERATORS ARE—and must be—alert at all times for an emergency. There can be no interruptions—no halt—to the constant flow of communication. They are "on the job" and willingly and cheerfully put up with many inconveniences, such as

waiting in all kinds of weather to travel on overcrowded buses and taking a long time to get to or from work. Others have left their homes and taken quarters in boarding houses and dormitories which are not as comfortable or desirable as their own homes. These girls are getting much satisfaction out of their work, however, because they know that their skill and ability are being applied at their highest usefulness.

THE ARMY appreciates the service they are giving and their desire to help in winning the war. A letter from the commanding officer at one of the camps to an official of one of the Associated companies reads as follows:

"Today is the first anniversary of the installation of my telephone, No. 1, in Camp ———— and the beginning of operation of the switchboard. During this year of service many calls have been placed, both local and long distance. It is with pleasure that I commend you and your fellow workers for the splendid service you have given us. It is my desire that each and every one of your employees who served us so well during this past year be commended for their part in this project.

"During recent weeks, since war has been declared, it has been our lot, here in ————, to be on duty twenty-four hours a day. Troops are moved on less than two days' notice. Sometimes it is necessary for troops to move from one part of the Camp to another within a twenty-four-hour period. All this required extra service on the part of your men in moving the telephones as required.

"Your lady operators, located here in Camp with us, have proven their merit by constant attention to duty. Please convey to them my personal thanks for their part in this program of national defense.

"Again permit me to congratulate you and your company for the excellent service you have given us here at Camp ———— and the voluntary coöperation exhibited by all."

Such an expression of satisfaction with the service they are giving is naturally very gratifying to the operators at Camp ————. But to them and to their sister operators at Army establishments throughout the United States, the highest satisfaction must lie in their realization that through them the Bell System is contributing in still another important and effective way to the success of military preparations and thus to the nation's victory in this war.

THE IMPORTANCE of communications to the Navy under the present conditions cannot be overestimated. Telephone people are all part of an "invisible navy" and, as such, are vital to the armed services in their prosecution of the war just as are the sailors on a battleship or the Marines on Guadalcanal.

From a letter from Vice Admiral F. J. Horne, Vice Chief of Naval Operations, to Vice President and General Manager C. A. Robinson of the C. & P. Telephone Co.

Now Numbering 69,000, This Group of Telephone Men and Women Forms a Strong Link between Achievements of the Past and Greater Accomplishments Still to Come

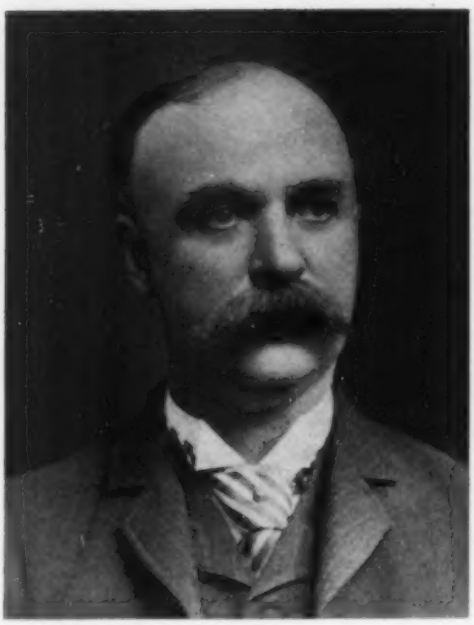
The Telephone Pioneers of America

Samuel T. Cushing

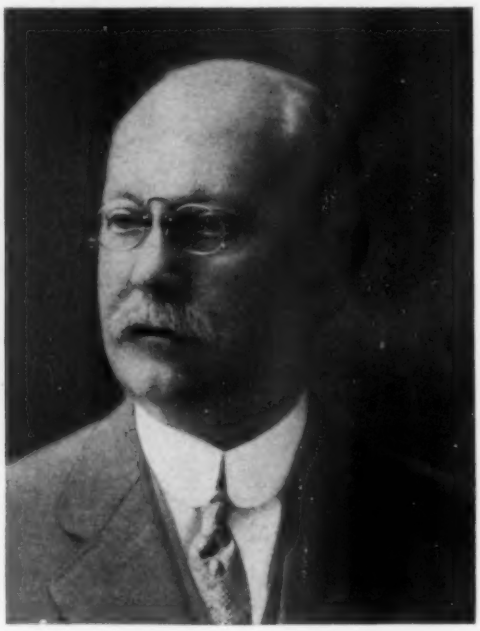
IN THE FALL of 1910 three telephone men, Henry W. Pope, Charles R. Truex, and Thomas B. Doolittle, began to discuss an idea which was destined to point the way to the development of an unusual organization, membership in which is one of the most satisfying of all the experiences that come to those who find their careers in telephone work.

At the time of this initial discussion the American Telephone and Telegraph Company had been in existence 25 years. In a few months, long distance conversations would be possible between New York and Denver, a milestone in the increasing range of the spoken word in America. Some months later, it would be possible to talk by underground cable all the way from Boston to Washington. And, as a result of the steadily growing public acceptance of the telephone as an aid to living and working, there were in the United States nearly 6,000,000 telephones owned by or connecting with the Bell System. Such were the evidences of telephone growth in the 34 years since Bell had demonstrated his telephone at Philadelphia's Centennial Exposition in 1876.

The three men, Pope, Truex and Doolittle, had not only watched this growth from the beginning; they had themselves played important parts in bringing it about. The first two, who in 1910 were at the headquarters of the American Company, had begun their telephone careers in 1878 and 1879 respectively. Both had had long and eventful experience as participants in the telephone's establishment and development in the important area of metropolitan New York. Thomas B. Doolittle's invention of hard drawn copper wire, adopted by the American Bell Telephone Com-



Charles R. Truex



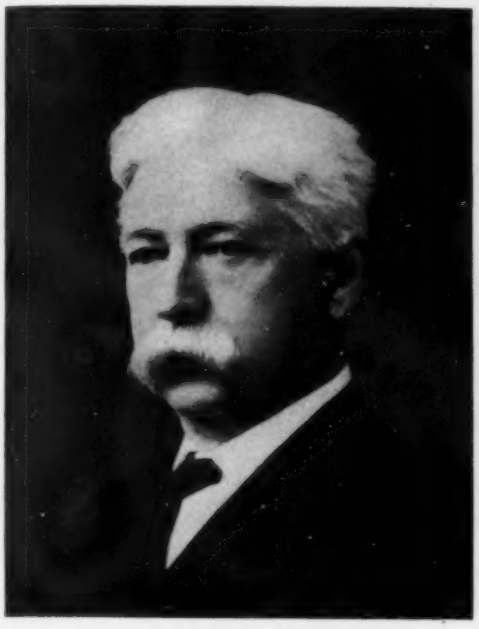
Henry W. Pope

pany in 1883, had revolutionized both telephone construction and telephone transmission technique; and in addition to his long service as a telephone engineer, he was one of the incorporators of the American Telephone and Telegraph Company.

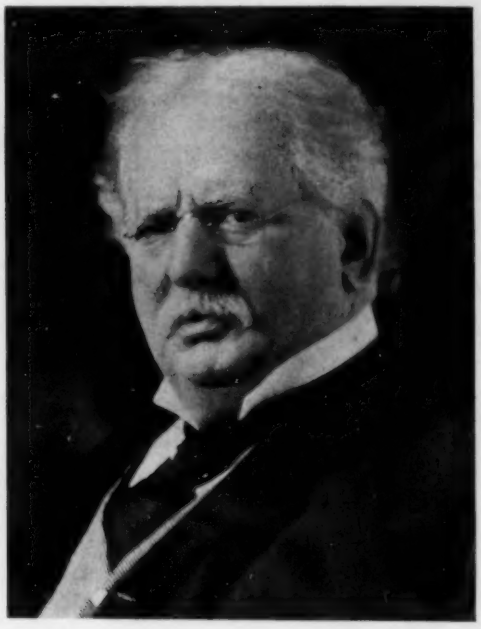
Thus these three men had truly pioneered in the development of a great and growing public service. They had felt the pride of noting its ever-broadening scope, its ever-increasing usefulness. And having the personal satisfaction of all whose pioneering work has contributed to such development, it was not strange that they should, with enthusiasm, discuss the idea—originally proposed by Pope—of forming an association of other telephone men and women with the same memories and the same satisfactions.

Nor was it strange that Theodore N. Vail, President of the American Telephone and Telegraph Company, whose advice they sought, should greet the proposal with equal enthusiasm. No one realized better than Mr. Vail what it meant to pioneer, for, as general manager of the early companies formed to organize and promote telephone growth, and as the first president of the American Company (1885–1887) to which responsibility he had returned in 1907, he had a complete knowledge and a full appreciation of the struggles and accomplishments that had brought about telephone service in America on a scale equaled nowhere else in the world.

With Mr. Vail's full approval of the idea, the three men constituted themselves an organizing committee to develop the movement for an association of long-service telephone



Thomas B. Doolittle



Theodore N. Vail

people. They first secured, by personal visits, the signatures of 169 near-by prominent telephone men of the early days on a "membership paper," dated October 1, 1910, and reading as follows:

"It has seemed advisable to a number of the pioneers of the Telephone industry to form an Association, to embrace, to such extent as may be found practicable, the early workers in the telephone fields, under the proposed caption of

THE TELEPHONE PIONEERS
OF AMERICA

for the purpose of renewing and perpetuating friendships, and fostering and encouraging such other worthy and appropriate purposes as may from time to time be suggested and approved.

"You are cordially invited and requested to indicate, by the affixing of your signature hereto, your willingness to join in the formation of such proposed Association.

(*Signed*) HENRY W. POPE."

Having thus secured the support of men who were easily reached, the organizing committee sent a letter on March 1, 1911, to the more distant early telephone men asking them whether they wished to apply for membership in the proposed organization. In this letter the tentative membership requirements were stated as being: "That any person of good standing engaged or employed in the service twenty-five years prior to date of application and at any time thereafter continuously in the Bell service for five years is acceptable." The membership requirement was changed later to twenty-one or more

years of service in the telephone industry.

The First Meeting

NAMES OF APPLICANTS were received in considerable number in response to the committee's letter, and on August 21, 1911, a call was sent out for the first meeting of Telephone Pioneers, to be held on November 2 and 3, 1911, at the Hotel Somerset in Boston, Massachusetts. Pioneers to the number of 250 were present out of an initial membership of approximately 500. President Vail of the American Telephone and Telegraph Company was elected the first Pioneer President, and Henry W. Pope the first Secretary. Among the notable addresses presented was that by Alexander Graham Bell, the telephone's inventor.

THE PIONEER EMBLEM has a definite symbolism. The three sides represent fellowship, loyalty, service. The numerals on the bell are those of the Patent Office number assigned to Bell's patent on the fundamental principle of the telephone. It was in 1875 that Bell verified his theory of the electrical transmission of speech; in 1911 that the Association was organized

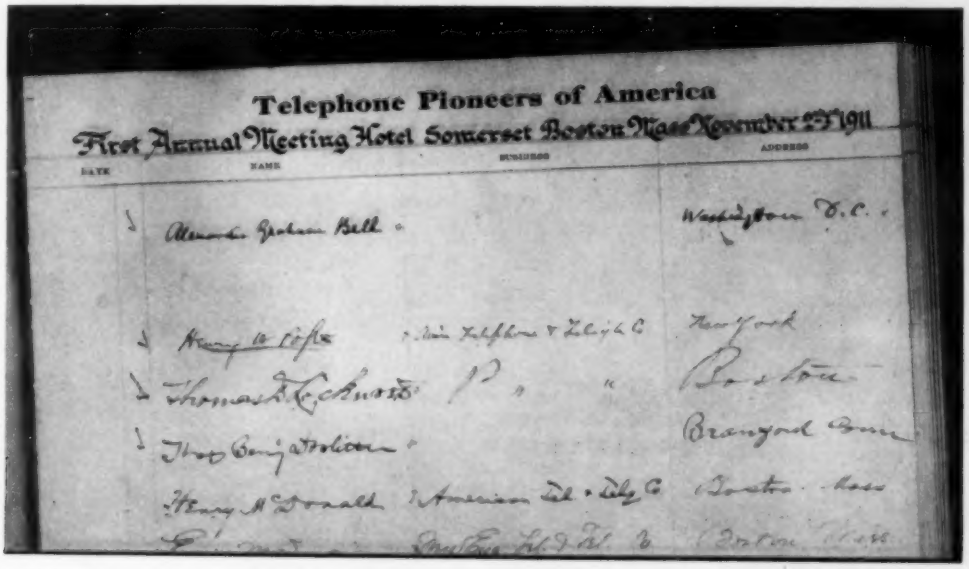
The constitution which was adopted contained the following statement as to purpose:

"The Association is formed for the purpose of recalling and perpetuating the facts, traditions and memories attaching to the early history of the telephone and the telephone system; preserving the names and records of the participants in the establishment and extension of this great system of electrical intercommunication; the promotion, renewal and continuance of the friendships and fellowships made during the progress of the telephone industry between those interested therein; and the encouragement of such other meritorious objects consistent with the foregoing as may be desirable."

THUS WAS BORN the organization whose members today, 69,000 strong, are in every state of the Union and every province of Canada. They range in age from a few who are but 35 years old to a nonagenarian of 95. It is an organization of unique character since, though organized and administered separately from the telephone operating organizations, it constitutes an important agency in the life of the entire telephone industry. It welcomes to its membership craftsman, clerk, operator, supervisor, executive, laboratory scientist, with no distinction as to level or position, but only with the requirement that each member shall have served the telephone industry for 21 years. It is in effect an honor society of men and women united by the common bond of having given on the average a generation of service to the building of telephone tradition and the maintenance of telephone ideals.

In its first decade the principal activity of the Pioneers' Association

consisted of holding annual conventions attended by large numbers of Pioneers and their guests, who welcomed these opportunities to renew the friendships formed in early telephone days. The second meeting was held in New York City in November, 1912. No meetings were held in the years of 1917, 1918, and 1919 because of war conditions. Mr. Vail continued as President of the Pioneers' Association until his death in 1920.*



ALEXANDER GRAHAM BELL'S signature stands alone at the top of the register for the first meeting. Second and fourth are those of Messrs. Pope and Doolittle. Mr. Truex, late in registering, signed on the last page

At the annual Pioneer convention at St. Louis in 1921 a most significant step was taken: provision was made for the formation of Pioneer chapters; and for the creation of a General Assembly, composed of the Association officers and representatives of the chapters, as the legislative body of the Association. By that time the membership of the Association had risen to about 2,200 and was thinly spread over most of the United States and Canada, with concentrations of considerable numbers in the principal cities. It was felt that the purpose of the Association would be better served if, by separating the membership into chapters, opportunity were provided for meetings and other activities by various groups locally, with a yearly gathering of representatives of the local units for the transaction of Association business.

* At the end of this article will be found a complete list of his successors in office, with their company titles at the time of election.

Chapters Are Formed

FOLLOWING THIS constitutional authorization, the work of organizing chapters started. In July, 1922, the first five chapters were chartered: Theodore N. Vail at Chicago, N. C. Kingsbury at Cleveland, Kilgour at Cincinnati, Wisconsin at Milwaukee, and Empire at New York City. By the time of the General Assembly Meeting at Cleveland in September, 1922, there was a total of 19 chapters. At first, delegate representation was on the basis of membership, and 65 delegates were present at Cleveland. Later it was stabilized at a figure of two delegates per chapter. Annual General Assembly Meetings continued until 1941, the meeting that year being at Chicago. Then came the war and, as a matter of patriotic necessity, the meeting planned for Detroit in 1942 was cancelled. It is probable that no more General Assembly Meetings will be held until after the war.

With the formation of chapters, membership increased rapidly. By the end of 1930 there were 18,500 members in 41 chapters. Ten years later the membership had risen to 48,000 in 56 chapters. Now there are 69,000, of which 4,500 are in the six chapters in Canada. It is expected that by the end of 1947 the total membership will be approximately 100,000.

While speaking of membership, it may be well to deal with a misconception held by some who believe that the Pioneers' Association is composed largely of oldsters. This, of course, is not so. Proud as the Association is of its life members, these retired employees constitute only about one-seventh of the total membership. Of the 59,000 employed members, approximately 75 per cent are under 50 years of age and 50 per cent under 45 years.

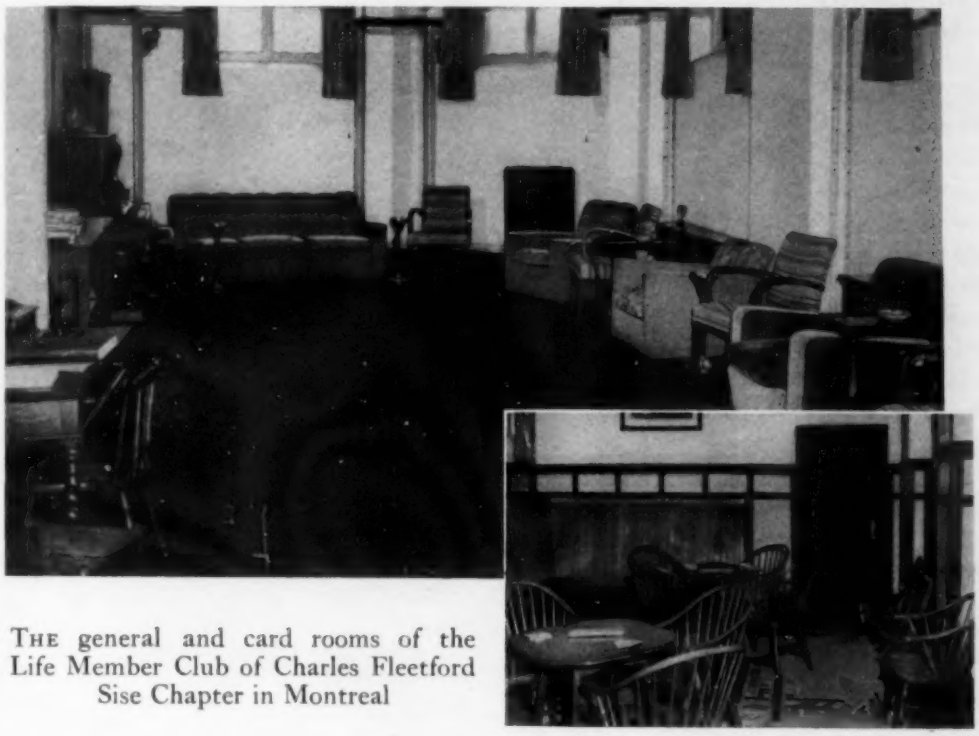
Chapter Meetings and Other Activities

THE INITIAL DEVELOPMENT of the chapters centered chiefly around the holding of meetings which reproduced on a small scale the larger General Assembly Meetings. The emphasis, of course, was entirely social. These meetings, large or small to meet each particular situation, have from the beginning achieved the fraternal purpose intended and it is expected that they will continue to perform this function.

Soon after the chapters were formed, it became evident that a program of Pioneer meetings alone was not sufficiently broad to fulfill the Pioneer objective completely, and in various ways the Pioneer program has been expanded through the years. First among these additional activities is the visiting of members who are ill, bereaved, or in other difficulty. Added to this is the sending of cards and flowers in cases of illness and bereavement. Practically all of the chapters carry on this type of activity to a greater or less degree. A year's work throughout the Association includes a total of approximately the following:

Visits to sick members	2400
Visits to bereaved members or families	500
Cards or letters to sick members	2000
Cards or letters to bereaved members or families	500
Flowers or other gifts to sick members	1600
Funeral floral pieces sent	900

As the number of members in the Pioneers' Association increased and the number of those who were retired began to assume considerable proportions, it became apparent that some special membership treatment should be accorded these retired people. Accordingly, in 1930, the General Assembly provided that the Executive Committee might confer life membership (with dues remitted) upon members retiring from active telephone service. The life membership roll has now risen to over 10,000, a highly honored group of Pioneer veterans. As they are able, these life members attend the meetings of the chapters and engage in various chapter activities. Many of the chapters pay especial attention to their life members, visiting them on various occasions during the year, particularly if they are ill, sending them Christmas and other greetings, and maintaining contact in other ways. In a number of chapters the life members have formed life member clubs, with their own clubrooms and regular programs of meetings.



THE general and card rooms of the Life Member Club of Charles Fleetford Sise Chapter in Montreal

Historical Work

NOT ONLY because required by constitutional provision, but naturally because of the character of its membership, the Pioneers' Association has applied itself to things historical.

This interest has been expressed in various ways. One of the most common has been the gathering of telephone equipment and material of the early days, old manuscripts, and photographs. In some cases, these collections have been given very appropriate display treatment through the coöperation of the telephone companies. Many of the chapters have chronicled their own histories. Many record, by photograph and the printed word, the biographies of their life members.

AT THE Chicago General Assembly Meeting in 1941 a project was launched which it is expected will eventually provide a history of the development of the telephone business in each telephone company. It was patterned after the undertaking of this type which has been so successfully carried into its final stages by the Southwestern Bell Telephone Company. The plan is for each chapter of the Telephone Pioneers to gather, particularly through its older members and through the search of newspaper files and other records, information regarding the beginnings and development of the telephone business in its territory, and to compile this information for further treatment. During these stages of the work, clerical and other assistance will be provided by the company personnel relations department; then the compiled material will be taken by the information and public relations department and written into final form.

The coming of war has forced the chapters which had begun work on such histories to confine their efforts largely to the preliminary phase of gathering the basic information from their older members. It is expected that all of the chapters will join in this portion of the work and that the more advanced stages of the historical project will be undertaken after the war.

A number of the chapters have made good progress in developing interest in hobbies, particularly on the part of their older members. It is recognized that a person who has a hobby reaches the retirement age with a much greater certainty of having a happy leisure than one who has not such a sustaining interest. Effort is made, therefore, through hobby shows, talks on hobbies, group gatherings of hobbyists, etc., to create and maintain such an interest on the part of members.

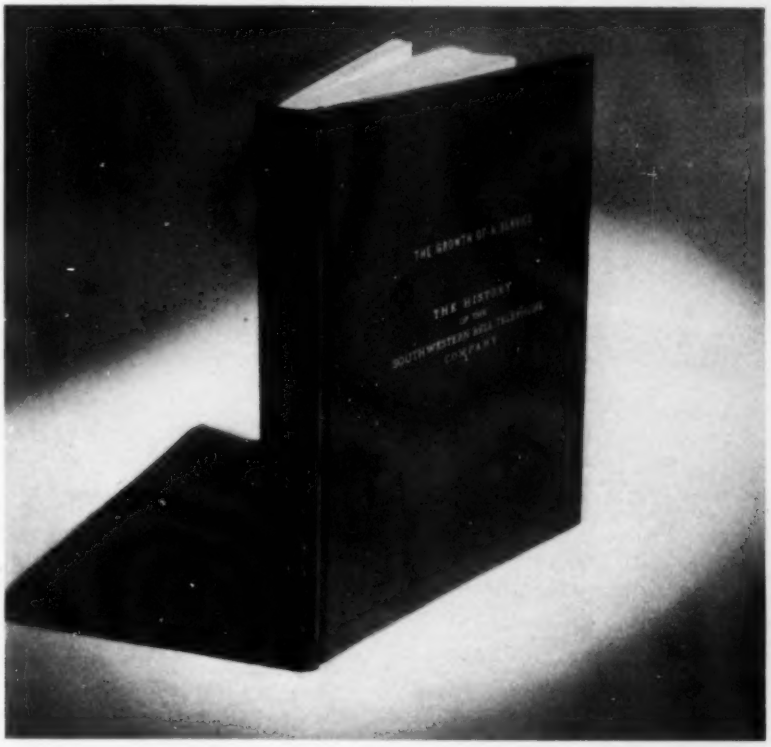
About a dozen of the chapters publish chapter periodicals. These publications vary in frequency of issue, but all have the common purpose of creating another bond among members and carrying the Pioneer message to all, particularly to those who, because of remote location, find it difficult to attend Pioneer meetings.

Chapter Goals

ALL OF THE ACTIVITIES already mentioned, and several routine interests, such as membership committee work and dues collection, for example, are covered by a stated series of objectives termed "Chapter Goals." This statement of the aims of Pioneer accomplishment has been established as an indication of what is considered good Pioneer work. Several of the chapters are already meeting most of these objectives. In addition to

these stated activities, various Pioneer chapters carry on work of their own development, such as sending greeting cards on anniversaries, the selling of war savings bonds and stamps by life members, and contributing to welfare activities.

about the formation of Pioneer chapters so, beginning in 1930, further growth resulted in the organization of councils for local groups of members within various chapters. This made it possible to hold meetings in locations convenient for more mem-



PIONEERS in the territory of the Southwestern Bell Telephone Company compiled the data on which is based this history of the company—shown here in the form in which it has been submitted to the Chapters and others for final checking and revision

Councils and Smaller Groups

ONE OF THE most significant developments in Pioneer work has been the establishment, within chapters, of subdivisions known as councils. Just as growth in membership brought bers and to organize committee work on a local basis within easier reach of the membership.

Further growth of membership in the larger chapters with widespread territories brought about the subdivision of some of the councils into

groups variously known as subcouncils, districts, clubs, and regions. With the coming of war and the resulting restrictions on transportation facilities, it soon became evident that it would be necessary to reduce considerably the distances which members would have to travel to attend meetings. Consequently, there has been a large increase during the last year in the number of chapter subdivisions, until now 29 chapters are subdivided into a total of 115 councils and, in addition, there are 45 subcouncils, clubs and other Pioneer groups within these councils. Each of the councils and smaller groups carries on a Pioneer program of its own, modified according to its size and location and integrated as a component part of the chapter program.

The Association

THE ACTIVITIES of the various chapters are coördinated and given general direction by a central organization which outlines the basic policies for the Pioneers' Association. The General Assembly, either at its annual meeting or by mail—as was the case for the first time in 1942—elects twelve officers as a governing body for the Association. These officers—President, Past President, Senior Vice President and nine other Vice Presidents—constitute the Association Executive Committee and in turn elect a Secretary and a Treasurer. The Secretary is the executive officer of the Association and, with a headquarters staff of six, carries on the routine business of the Association and maintains general supervision over its activities in line with policies established by the Executive Committee.

A recent change in the plan of administration has divided the Association territory into twelve Association Sections, with one of the Executive Committee members elected from and representing the chapters in each section. This plan of representation has a two-way application: each Executive Committee member is responsible to each of his constituent chapters for carrying its thoughts and ideas to the Executive Committee and, conversely, he is responsible for carrying to his chapters the thoughts and decisions of the Executive Committee. Furthermore, as a representative of that committee, he maintains contact with the chapters by personal visit and other means of communication, and stimulates and helps them in their work in every way possible. From the results already accomplished, it is evident that this plan will prove most effective in the work of the Association and the chapters.

The Association Secretaries

AS HAS BEEN SAID, the Secretary is the executive officer of the Association. Four persons have occupied this position during the life of the organization to date. Henry W. Pope, the "father" of the Telephone Pioneers and the first Secretary, served for three years. In that time he set the Association well on the road which it was to follow through the years to come. At the time of the fourth Annual Convention at Richmond, Virginia, in 1914, Mr. Pope was seriously ill and could not attend. His duties were performed by Roswell H. Starrett of the American Telephone and Telegraph Company and, because of the prospect of

Mr. Pope's continuing illness, Mr. Starrett was elected to succeed him as of January 1, 1915.

Mr. Starrett served as Secretary for more than seventeen years. While he was in office the Association grew through the years of larger and larger Annual Conventions and then embarked on its program of chapter formation and later development. When he assumed the secretarial position in 1915 the Association had a membership of 1,252; when he ended his term of service upon retirement in 1932, there were 21,221 members in 41 chapters.

Mr. Starrett was succeeded on June 1, 1932, by John Groener of the American Telephone and Telegraph Company. During his seven years of executive service the Association grew rapidly, adding 10 chapters and more than doubling its membership. In this period the movement toward the formation of councils and smaller groups within chapters, begun in 1930, saw extensive development. On May 31, 1939, Mr. Groener laid down the reins of office, and was succeeded by the present incumbent of the secretaryship, Samuel T. Cushing.

MEMBERS of the Hoosier State Chapter collected these old instruments and memorabilia, which are on display in the headquarters building of the Indiana Bell Telephone Company in Indianapolis

Association Publications

THE ASSOCIATION issues two publications. Each year, after the General Assembly Meeting, it has been cus-

tomary to send to each member a booklet describing the proceedings of the General Assembly and containing statistical reports and other information. As there was no General Assembly Meeting in 1942, the Executive Committee voted to issue and send to each member, instead of the usual "Proceedings," an "Annual Report for 1942" containing various items of general Pioneer interest, some statistics, and some news. These booklets were distributed in January, 1943.

The other Association publication is "Chats with Chapters," issued quarterly to all officers, committee chairmen, and principal workers in the chapters, councils, and other subgroups. The Association Secretary, as editor, is assisted by six associate editors located in different parts of the country. "Chats with Chapters" is essentially a "trade journal" for Pioneer workers and its material is written especially for these people.

In addition to these Association publications, the various company employee magazines report frequently upon Pioneer activities in their territories and, as previously mentioned, several chapters publish periodicals of their own development.

Statement of War-Time Policy

WITH THE ENTRY of the United States into the war, the question was immediately raised as to what effect the situation would have on Pioneer work. At its meeting in January, 1942, a month after Pearl Harbor, the Association Executive Committee issued "A Statement of Pioneer Policy in War Time," which began with the following preamble:

"With the United States and the British Empire joined in war against the Axis Powers, there is placed upon every individual and every organization the responsibility for reëxamining all interests and activities to determine whether or not they contribute to the war effort and, by this standard, whether or not they should be continued and with what emphasis.

"Review of the interests and activities of the Telephone Pioneers of America by the Association Executive Committee has resulted in the conclusion that the work of the Pioneers' Association should be carried on vigorously during war time, because of its value in building and sustaining morale, but that, at the same time, care should be taken to conserve energy and eliminate waste.

"The Executive Committee recommends that all of the chapters give immediate and serious attention to this matter, being governed in this connection by the following specific recommendations:"

Then followed recommendations regarding the holding of meetings and the carrying on of the various other Pioneer activities, all of the suggested action being keyed to war-time conditions. In the period since this "Statement of Policy" was written, the chapters have continued actively in the manner recommended, taking care to plan their work in conformity with the war-time situation.

The Pioneers' Association in the Years to Come

IT IS EVIDENT that there will be no lack of potential members of the Pioneers' Association in the years to come. For many years there will be

an increasing number of eligibles because of the force additions preceding the last depression. And the fact that the nation is at war does not seem to act as a deterrent to joining the Pioneers. During 1942, 7,190 new members were added, a larger number than in any previous year except 1941, when there was an especial emphasis on increase in membership.

whole extent of the country today? It is to you that this great development is due."

When the telephone's inventor spoke these modest words, transcontinental telephony was but a hope in the minds of the telephone's scientists and engineers, and today's system of 24,000,000 interconnected telephones was not even a dream. Radio telephony was an unborn art.

OLD TELEPHONE EQUIPMENT lends interest to this lounge and ante-room of the office of Theodore N. Vail Chapter in Chicago

And all who may join the Association in 1943 and in the years to come need have no doubts as to the continuing appropriateness of the term "Pioneer." Let them recall Dr. Bell's address at the first meeting of the Association in 1911: "You have all gone so far beyond me! Why, the little system that I look back upon—what is it compared to the mighty system that goes through the

Magnificent accomplishments in research, in apparatus design, in systems of transmission, in manufacturing technique, in operating methods were to mark the coming years and give to the telephone men and women of today an instrumentality of service almost beyond the conception of the early pioneer.

Yet, as Walt Whitman has written: "It is provided in the essence of

things that from any fruition of success, no matter what, shall come forth something to make a greater struggle necessary." The search for better instrumentalities and better methods goes on. The impulse toward improvement cannot be checked; for it is, by the very nature of their work, the controlling spirit of scientists, engineers, technicians—indeed, of all men and women who carry on and carry forward the service—and is an expression of the telephone management's conception of its trusteeship of a national service. All who may play a part in adapting the accomplishments of the future to the needs of men will know, from their own experience, that there always will be telephone pioneers.

Presidents of the Pioneers' Association

Succeeding Theodore N. Vail, President of the Telephone Pioneers of America from 1911 to 1920, have been the following:

1921—*Harry B. Thayer, President, American Telephone and Telegraph Company
1922—*John J. Carty, Vice President, American Telephone and Telegraph Company
1923—Leonard H. Kinnard, President, Bell Telephone Company of Pennsylvania
1924—Albert L. Salt, Vice President, Western Electric Company
1925—*Ben S. Read, President, Southern Bell Telephone and Telegraph Company
1926—*Harry B. Thayer, Chairman, American Telephone and Telegraph Company
1927—*James T. Moran, President, Southern New England Telephone Company
1928—W. Rufus Abbott, President, Illinois Bell Telephone Company
1929—Eugene D. Nims, President, Southwestern Bell Telephone Company
1930—James S. McCulloh, President, New York Telephone Company
1931—*Burch Foraker, President, Michigan Bell Telephone Company
1932—Frederick H. Reid, President, Mountain States Telephone and Telegraph Company
1933—Albert B. Elias, President, Southwestern Bell Telephone Company
1934—*W. B. T. Belt, President, Northwestern Bell Telephone Company
1935—†B. L. Kilgour, President, Cincinnati and Suburban Bell Telephone Company
1935-36—‡Chester I. Barnard, President, New Jersey Bell Telephone Company
1937—James L. Kilpatrick, President, New York Telephone Company
1938—Philip C. Staples, President, Bell Telephone Company of Pennsylvania
1939—Walter S. Gifford, President, American Telephone and Telegraph Company
1940—John J. Robinson, President, New England Telephone and Telegraph Company
1941—N. R. Powley, President, Pacific Telephone and Telegraph Company
1942—George M. Welch, President, Michigan Bell Telephone Company
1943—A. H. Mellinger, President, Illinois Bell Telephone Company

* Deceased. † Died Jan. 28, 1935. ‡ Succeeded B. L. Kilgour Feb. 14, 1935.

Weather: Clear and Cold

A severe blizzard last January isolated the Jackson central office of the Mountain States Telephone and Telegraph Company, in the wild "Jackson's Hole" valley in the northwest corner of Wyoming. Combinationmen John C. Thompson, Jr., and Arthur D. Cottrell, of Lander, Wyo., were dispatched westward to find and clear the trouble east of Jackson. Mr. Thompson wrote for the company's employee magazine, The Monitor, *an account of their trip which is here reprinted as giving a vivid picture of trouble-shooting under conditions which fortunately are unusual in most Bell System territory.*

Lander, Wyo., Sunday, Jan. 24, 1943, 2:30 P.M. *Weather: Clear and Windy.*

TELEPHONE CALL from Jim Fegley, Lander, Wyoming manager: "How would you like to take a trip—over the Pass?" In other words, the Lander-Jackson toll line was in trouble somewhere beyond Dubois. Art Cottrell and I checked out of Lander with all the usual equipment, snowshoes included, at 3 P.M.

Reached Dubois at 6 P.M. Snow 14 inches deep, weather clear and cold.

Checked in at the Stringer Hotel, Dubois' only haven for travelers. We were entertained by the Stringer brothers, Albert and Oscar, 69 and 67 years. Due to war conditions, no cook was available and the brothers are alternating weeks in the kitchen.

Dubois, Wyo., Jan. 25, 1943, 8 A.M. *Weather: Clear and Cold.*

CHECKED WITH Casper Toll Test and found that the Jackson circuits from Idaho were out and that all highways were blocked.

We reported out at 8:30 A.M. and were accompanied by A. G. Boland, owner and manager of the Dubois Telephone Company, who had agreed to return the truck to Dubois, after we had gone as far as possible in it.

As we left town, a herd of about seventeen elk were grazing on a hill at the city limits. Moose and elk tracks were in evidence from the start of the trip, and the animals were in view at nearly every point on the road. Unusual snow conditions had driven them out of the high country.

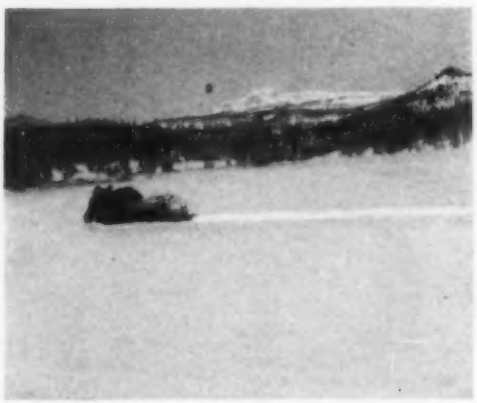
Twenty miles out we followed two moose for a mile until they finally left the highway.

We reached the end of the road (literally) at 9:30 A.M. and were on our way. The snow was seven feet deep at this point.

We had covered about two miles, when a moose was sighted, feeding on willows, directly in our course. As we approached, he moved away and at one time only the tip of his ears and hump were visible, moving across the snow field, much as a mole burrows in soft ground. We were able to get within twenty feet of him

and snapped a picture as he rested, and as he moved away. We were fortunate that he was old and "wanted to be alone." Moose dispositions are notoriously bad and they will attack anything and everything in sight if they are annoyed.

Continuing on, we found the snow getting deeper and softer until, as we entered the timber, we were sinking eight or 10 inches in spite of the webs. Travel was very tiring be-



HE "wanted to be alone." A moose enountered on the second day out

cause each foot had to be raised at least 12 inches to clear the snow.

At 2:30 P.M. we had reached the foot of the hill and at 4:30 had progressed only a mile farther. We were in the right of way adjacent to Tanner Park. We stood on the snow and connected the test set to the line, notified Lander and Casper of our location, and headed for Tanner Park Cabin.

As we webbed through the pines, many of them more than a hundred feet high, a jay joined us. He was one of the two livings things seen between Tanner Park and Togwotee Lodge, and he escorted us to the cabin.

In traveling through the timber we missed the Park and had to backtrack a mile, so we reached the shelter cabin at 6:10 P.M., having covered only 5.5 miles in the course of nine hours of constant snowshoeing. We were pretty weary, and while Cottrell cut wood for the night I started a fire and got a meal of fried canned meat, noodle soup, and coffee. We rolled out the bedding and "died" for the night. The cabin was so warm that a mouse came out of hibernation and spent the night building a nest in one of the pack sacks.

Tanner Park Cabin, Jan. 26. Weather: Clear and Cold.

WE WERE UP and eating breakfast at 8:00 A.M., and as we left the cabin we gauged the snow depth with a pole and took a snapshot of Cottrell in front of the only visible part of our first night's shelter. The snow depth was nine feet on the level.

At 9:30 we had reached the line and checked out with Lander and Casper. The seven miles to Togwotee Pass was just as slow going as the first day and was uneventful. We made the second leg of the trip in nine hours and at 6:00 P.M. were struggling with the old fashioned coal stove in the Togwotee (Highway camp) cabin.

Togwotee Cabin, Jan. 27. Weather: Cloudy and Warm.

DURING THE NIGHT it laid down an additional three inches of fresh snow and was cloudy and warm the morning of the 27th. We called Casper

and decided to wait an hour for the weather to change.

At 10:00 A.M. the clouds were breaking, and after gauging the snow depth at eight feet, and calling Casper, we were on our way. The nine miles ahead were the worst of the entire trip. The first five miles were covered without any trouble, but when we pulled out into the open park we found the snow soft and wet, a ground blizzard in progress, and more snow falling. Visibility was ten feet.

Two miles from Togwotee Lodge we heard the motor of the snowmobile coming toward us, but in the time it took us to travel a hundred yards the sound receded. Cottrell's feet had begun to bother him and exhaustion was showing up, every step was an effort, and after what seemed hours we broke into the Togwotee Lodge Park. I went to the line and heard Don Williams, Jackson, Wyo., manager, calling Casper from Turpin Meadows. Cottrell was unable to travel any further, so we had the snowmobile come to Togwotee Lodge and pick us up. [Mr. Williams had obtained the snowmobile and started east. He restored service by removing 21 trees from the line on the west side of Togwotee Pass before meeting the two Lander men.—*Ed.*]

It was necessary to abandon our packs and lighten the snowmobile load as much as possible because of the fall of fresh wet snow.

We reached Turpin Meadows Lodge at 8:00 P.M., and were treated to a well prepared meal of steak and baked potatoes.

After supper we were assigned sleeping quarters, and examined and dressed Cottrell's feet.

Jan. 28, 1943. Weather: Clear and Cold. Snow depth 5 feet.

WE WERE UP at 7:30 A.M. and got under way. Cottrell and the snowmobile pilot were to go on ahead, Don and I were to follow on snowshoes. The snowmobile traveled a couple of hundred yards, only to stop with a broken ski support. Don and I made sure that Fred Abercrombie, owner and operator of the "sled," would be able to fix it and then went on ahead.

THE SNOWMOBILE: a small, light body mounted on ski runners and driven by an airplane propeller

We had been traveling for about an hour when it and its two passengers passed us.

We were traveling in moderately deep, wet snow, but were making good

time (about 2 miles per hour). It was necessary to watch for moose constantly, and when one was sighted its movements had to be observed so that any indication of "off color" action would be noted in time to give

MR. THOMPSON on eight feet of snow. Note the snow-covered roof of Togwotee cabin behind him

us warning to start for the closest tree in sight.

Don and I overtook the snowmobile in about ten miles and we all decided to try to reach the Elk Ranch, five miles further on.

At 8:00 P.M. we had all reached the ranch but were unable to call Casper because of line trouble on the rural circuit from the ranch. We were too tired and hungry to web a mile back to the toll line to call. We reasoned that four men in a group would fall into no difficulty and therefore the Toll Test must figure the same way.

We had supper and were assigned quarters for the night. While three of us were resting, Fred Abercrombie borrowed a welding outfit from the ranch mechanic and repaired the broken support on the snowmobile.

Jan. 29. Weather: Clear and Cold.

COTTRELL AND ABERCROMBIE started for the last leg of the trip at 8:00 A.M. and Don and I hitched a ride on the covered wagon sleigh which two little boys from the ranch drove to school at Moosehead Ranch, four miles down the Buffalo River. En route, moose were seen at every stackyard in the area.

Leaving Moosehead Ranch, we continued on toward Jackson. Travel was not difficult and we made good time. At 3:30 P.M. we heard and sighted the snowmobile returning for us.

Boarding the snowmobile, we traversed the last twelve or thirteen miles to Jackson in an hour and a half. All that remained now was to arrange transportation for Cottrell and myself to Rock Springs. Cottrell's feet were examined and dressed by the doctor in Jackson, finding no infection in evidence. We registered at the hotel and had supper and a night's rest.

What Radar Is and Does

The following statement, made by President Oliver E. Buckley of the Bell Telephone Laboratories during the "Telephone Hour" radio program on May 17, is particularly significant when read in connection with "American Science Mobilizes for Victory" on page 106.

THIS WAR is being fought on many fronts, and the scientific front is one of the most important of them all. To insure that we shall win, our scientists must always keep one jump ahead of those of the enemy in the invention and development of new military instruments.

It is significant, therefore, that the scientists of the United States are effectively mobilized to do their part. Most of the work they do must be kept secret, but recently some information has been released on one of the products of their scientific effort—a new tool of war which has brought much disaster to our enemies.

This new tool is "radar," a device for detecting and locating enemy ships and airplanes. Radar works by sending out a beam of radio waves which, when it hits an object, is reflected and caught on the rebound. Thus the reflected radio wave gives warning of the enemy's approach. But it does more: it tells his exact distance and direction. The direction is that of the incoming reflected wave, and the distance is determined from the time it takes for the radio wave to make the round trip out to the enemy object and back. Knowing both direction and distance, guns can be trained on an enemy ship or airplane, even though hidden from sight by darkness or fog.

Radar takes many forms and sizes for different conditions of use, but all work on the same fundamental principle. Like all complicated devices, it is not a single invention but the product of many inventors and designers.

Three years before Pearl Harbor, Bell Telephone Laboratories was already working with our Army and Navy in the development of military radar. Other industrial laboratories joined in this effort. Through the National Defense Research Committee, an organized attack on radar problems was made by a group of leading scientists recruited from universities. All told, some two thousand scientists and engineers in Army, Navy, university, and industrial laboratories joined hands in the development of radar.

Bell Telephone Laboratories, a pioneer in the study of radio transmission and reflection, was in an outstanding position to contribute to the new art of radio detecting and ranging. All we had of technical knowledge and skill was thrown into the common pool. Wholeheartedly, we joined our efforts with those of other groups in this country and England. The radars which our forces are using

today are the result of this joint effort, coupled with the skill and workmanship of the several manufacturers who are enlisted in production. Prominent among the makers of radar is the Western Electric Company, manufacturing unit of the Bell System.

We of Bell Telephone Laboratories are proud of our contributions to this new instrument of war—one of many on which we have worked. We are proud, too, to have played a leading part in this greatest demonstration of teamwork that scientists have ever made.

ALTHOUGH PRACTICALLY ALL research and development effort has been diverted to the purposes of the war, the flow of developments affecting telephone service is not immediately curtailed, for they are the continuing result of ideas and techniques developed in the previous period of research. At present, telephone service is helped by the researches that have been carried out in the past. In fact, if it were not for the products of past research, the Bell System could not cope with the present emergency. Wires which formerly carried single conversations now carry many. Failures of equipment are avoided through greater reliability which has been achieved by research. Machines have been devised to do much of the work formerly done by hands. So the present shortages of materials and men, serious as they are, are nothing like as serious as they might have been.

From the A. T. & T. Annual Report for 1942.

I SHALL NOT ATTEMPT to predict what the coming year will bring for the Bell System, as it necessarily depends, under war conditions, on so many things that are beyond the control of the management. I assure you, however, that the System will continue to perform effectively and fully its important part in the war, and I promise you that we shall do everything in our power to see to it that the System comes through this trial of war fundamentally unimpaired and able to continue to furnish the American people with the best telephone service in the world.

The contribution to the war of the Bell System and of the men and women in it has been and continues to be outstanding; and when the war is over and the facts can all be told, I am sure that you as stockholders in this great private enterprise of a free country will be proud of the part it has played.

From President Walter S. Gifford's statement to A. T. & T. stockholders at the annual meeting on April 21.